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Preliminary

PLANT ASSOCIATIONS and HABITAT TYPES of the Shelton Ranger District Olympic National Forest

USDA • Forest Service
Pacific Northwest Region

PRELIMINARY PLANT ASSOCIATIONS AND HABITAT TYPES OF THE SHELTON RANGER DISTRICT, OLYMPIC NATIONAL FOREST

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PREFACE

This document represents the first approximation toward a comprehensive vegetation-site classifi-ation for this area. Organization and naming of the types should be viewed as tentative until field checking of keys and quantitative verification of types is completed. Preliminary results are presented in this form as a working tool in the process of development of the Area Guide. Feedback on the usefulness and clarity of the key and type descriptions to the author is welcome.

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INTRODUCTION

Vegetation is the major resource land managers manage. It covers 99% of the land and is the source of timber and food and cover for livestock and wildlife. It serves to hold the soil mantle in place protecting its own ability to survive besides keeping the soil from eroding into lakes and streams. It provides scenic backdrop and other visual qualities. It is easily manipulated and sensitive to natural catastrophes. Yet we know relatively little about it, its ecology or the ecological implications of its management.

What kinds of vegetation are there? Where do they occur? How sensitive are they? Are they equally suitable for deer or elk or sheep habitat? How do they respond to management treatment? How fast do they grow or regrow? Which plants or animals can be found where? The answers to these questions are tied up in the complex distribution patterns of plant communities and their interactions with the environment. In order to answer these questions in a way that will satisfy sophisticated managers as well as meet the considerable load of regulations imposed on land managers today, a system is needed which helps deal with the vegetational patterns, helps us understand the complex ecosystem interactions and provides a way to apply ecological knowledge for better management.

A beginning to the solution of these problems is the description of "kinds of vegetation" in a way that is both logical and natural and will help us communicate with each other about what we need and what we know.

Forest Cover Types and Range Sites have served partially to fill this need as have various vegetation or life-zone classifications. These are single-use classifications that fail to serve a wide need or are too broad to be of much use in land management. In fact, probably no single vegetation or ecosystem classification or description scheme will suffice by itself. We need a vegetation classification system that is internally compatible and meets the functional needs of managers.

The first step in addressing these questions is a classification and description of the potential vegetation of an area (Daubenmire and Daubenmire 1968; Hall 1970, 1973; Franklin and Dyrness 1973; Pfister et al. 1975). The potential (or projected climax) vegetation is in greatest equilibrium with its environment and is relatively stable. It is the most easily determined stage of successional development to which all other vegetation, regardless of stage or degree of disturbance can be (theoretically) related. It is the first step in trying to bring order to an otherwise bewildering mosaic of vegetation and vegetation-environment interactions. The basic unit of the potential vegetation is assumed to be the Plant Association.

STUDY AREA

The Shelton Ranger District includes about 135,000 acres (55,000 ha) in the southern Olympic mountains (Fig. 1). It covers primarily the Wynoochee and South Fork Skokomish rivers. About 74% of the area is in the western hemlock zone, about 23% in the silver fir zone and about 3% is in the mountain hemock zone, part of which is non-forested parkland or subalpine meadow zone.

The area is well roaded except for small roadless areas around Wonder Mountain, Capitol Peak, Church Peak, and Three Peaks. Much of the pre-settlement old-growth is now gone, with the rest to be cut within the next 6 years or removed from the near term cutting base. Old-growth stands suitable for sampling for Association descriptions are relatively few. This has affected the sampling scheme in much of the District to the extent that virtually all remaining uncut stands have been sampled.

Climate is generally moist maritime. Moisture-laden storms coming in from the Pacific blow across the southern part of the Olympic Mountains, dropping much of their moisture to the West, creating somewhat of a rain shadow effect from the west side of the district to the East (Fig. 2).

Bedrock is predominantly highly fractured basalt with some glacial deposits in the major drainages and in the southeast sector. Glacial-fluvial deposits fill the Wynoochee and S. Fk. Skokomish valleys. River cutting and meandering have eroded sections of this material leaving a distinctly terraced formation typical of the western Olympic valleys. Soils are mostly derived from steep colluvial material, are poorly developed, often shallow and highly erosive.

Topography is mostly steep dissected mountain valleys with many slopes over 60% and some forested slopes over 90%. Elevation ranges from under 500 feet (150 m) in the lower reaches of the S. Fk. Skokomish river to about 5,000 feet (1525 m) at Capitol Peak. Most elevations sampled ranged from 1,000 to 4,000 feet (300 to 1,200 m).

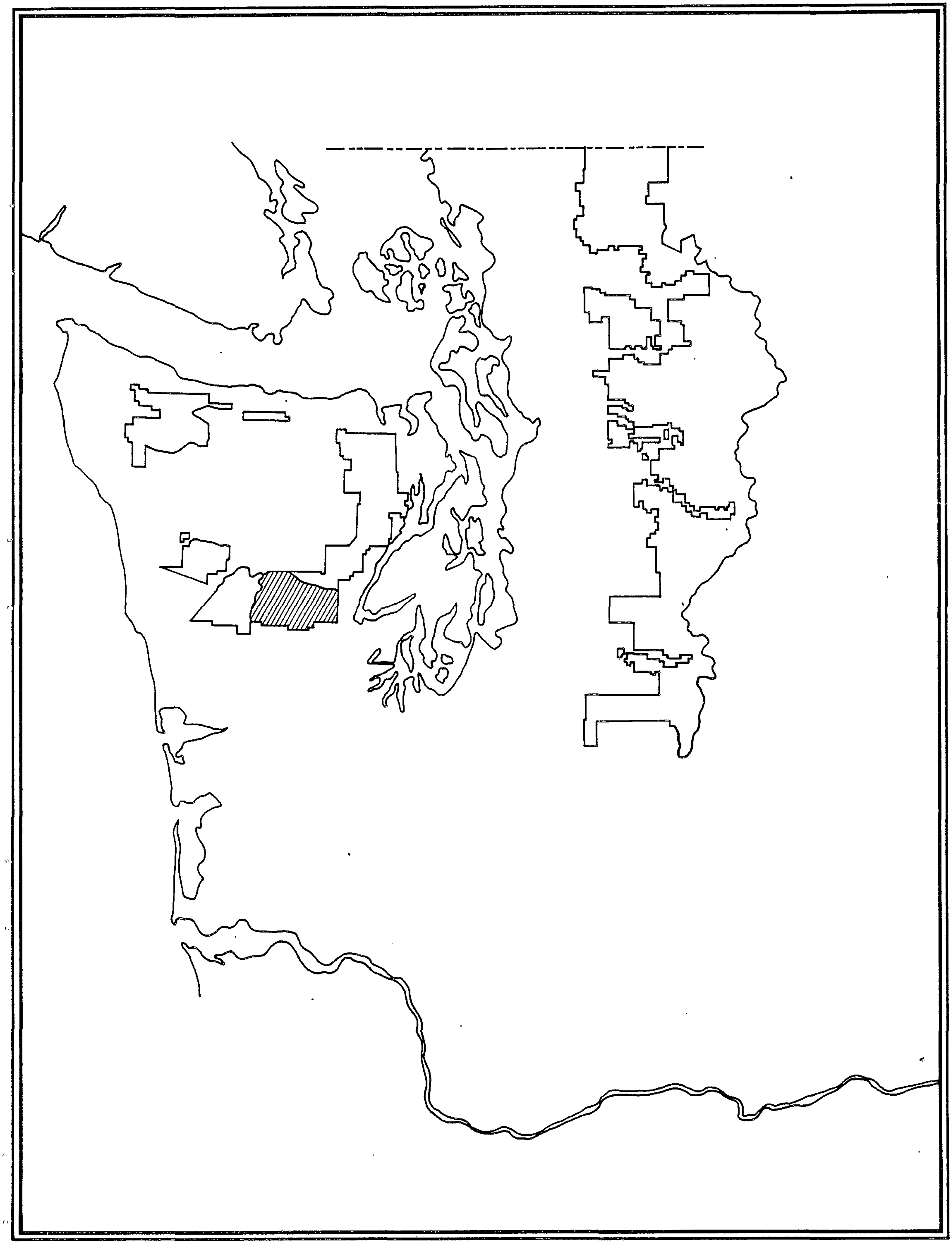

Figure 1. Map of Western Washington with the Study Area shaded.

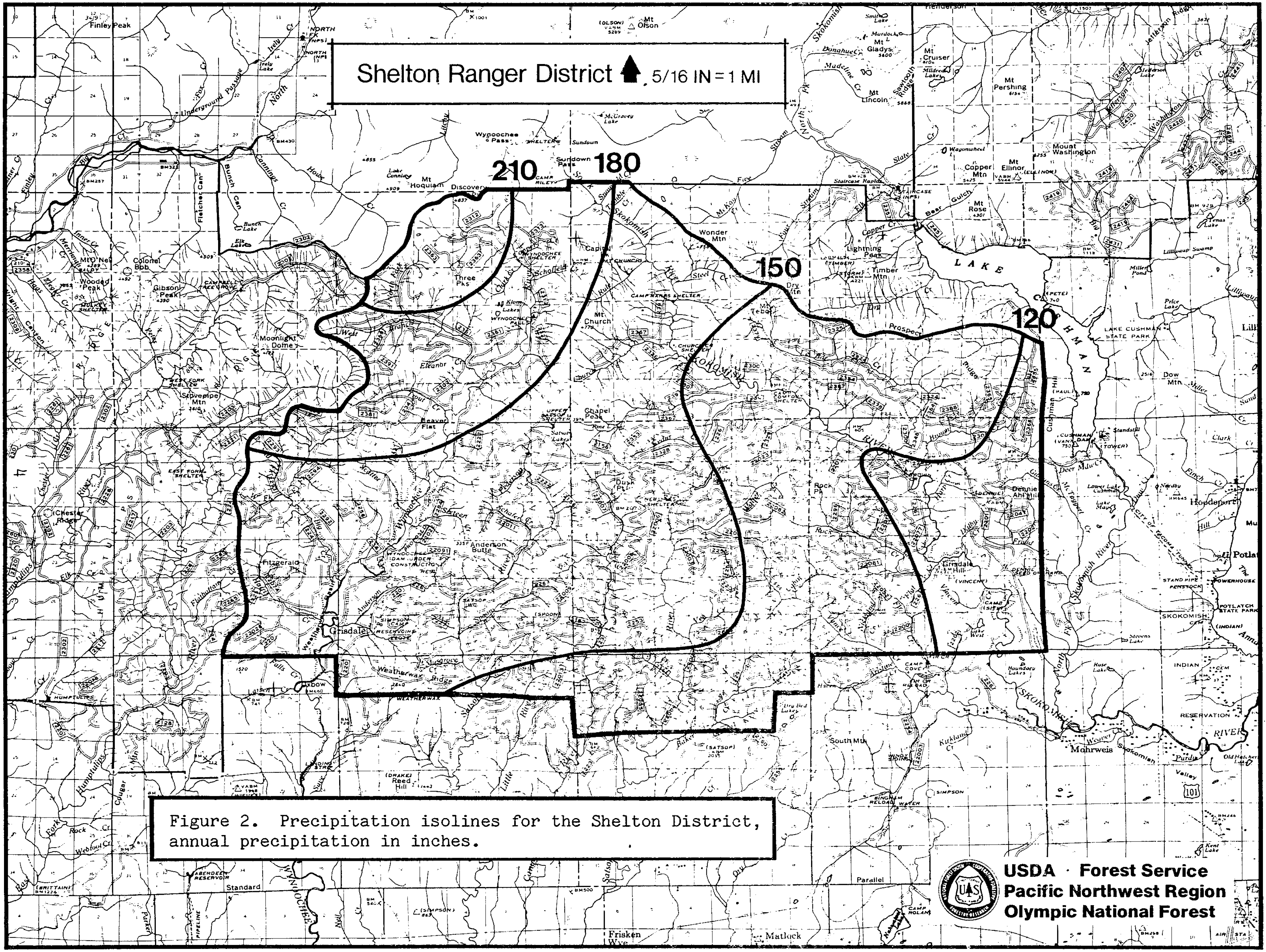

Figure 2. Precipitation isolines for the Shelton District, annual precipitation in inches.

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ECOLOGICAL PERSPECTIVE

Vegetation occurs over the landscape as a complex mosaic of various communities in different stages of development or disturbance and each responding to the gradients of environmental conditions (e.g., soil, climate, topography, temperature, etc.). Each community is the product of a different combination of environmental, biotic and historic factors.

Even if the effects of disturbance could be eliminated and all communities allowed to develop to the point where they are believed to be in equilibrium with the environment (climax?), the vegetation would still probably represent a continuum of communities when measured along a uniform environmental gradient over large distances. However, for any geographical area (in the western U.S. at least) environmental gradients are not uniform, and in fact marked discontinuities are common, with certain combinations of environmental factors occurring in the landscape more frequently than others. The segments of the vegetational continuum associated with those environmental "combinations" also occur more frequently. Therefore, although we recognize the continuum nature of vegetation, we analyze and portray it as natural segments or "types".

CLASSIFICATION HIERARCHY

The classification hierarchy used in delineating and defining units of vegetation (potential and actual) and units of land with similar ecological characteristics is intended to be the same that is being proposed for national usage by the interagency Resources Evaluation Team (RET).

The classification hierarchy emphasizes potential vegetation at the level of the Plant Association as the basic unit. Plant Associations are abstract units of the potential vegetation which are characterized by the same overstory and understory dominants. Phases are finer subdivisions of the Association based on secondary or indicator species, and Series are aggregations of Associations with the same overstory dominants. Küchler's Potential Vegetation Types (KPVT's) are equivalent to mapped series or groups of ecologically similar series. Regional formations (Biomes) are the next highest level above series in the currently proposed national classification.

The aggregate of all units of land capable of supporting a single plant association (at climax or stable-state) is called a Habitat Type. A Habitat Type is named for the Plant Association which characterizes it and may also have phases named for the Association phase.

Ecological Land Units (or Ecological Response Units) are areas of land with similar responses to treatment and reactions to the environment and are at least partially defined and delineated on the basis of the Habitat Type.

In addition to the potential vegetation types, it is also useful to recognize plant community types and plant communities. Plant communities are the actual entities which occupy the landscape. The plant community type is an abstract aggregation of similar communities which may or may not reflect their successional condition. However, a climax community type is considered synonymous with Plant Association. The classification hierarchy is outlined in Figure 3.

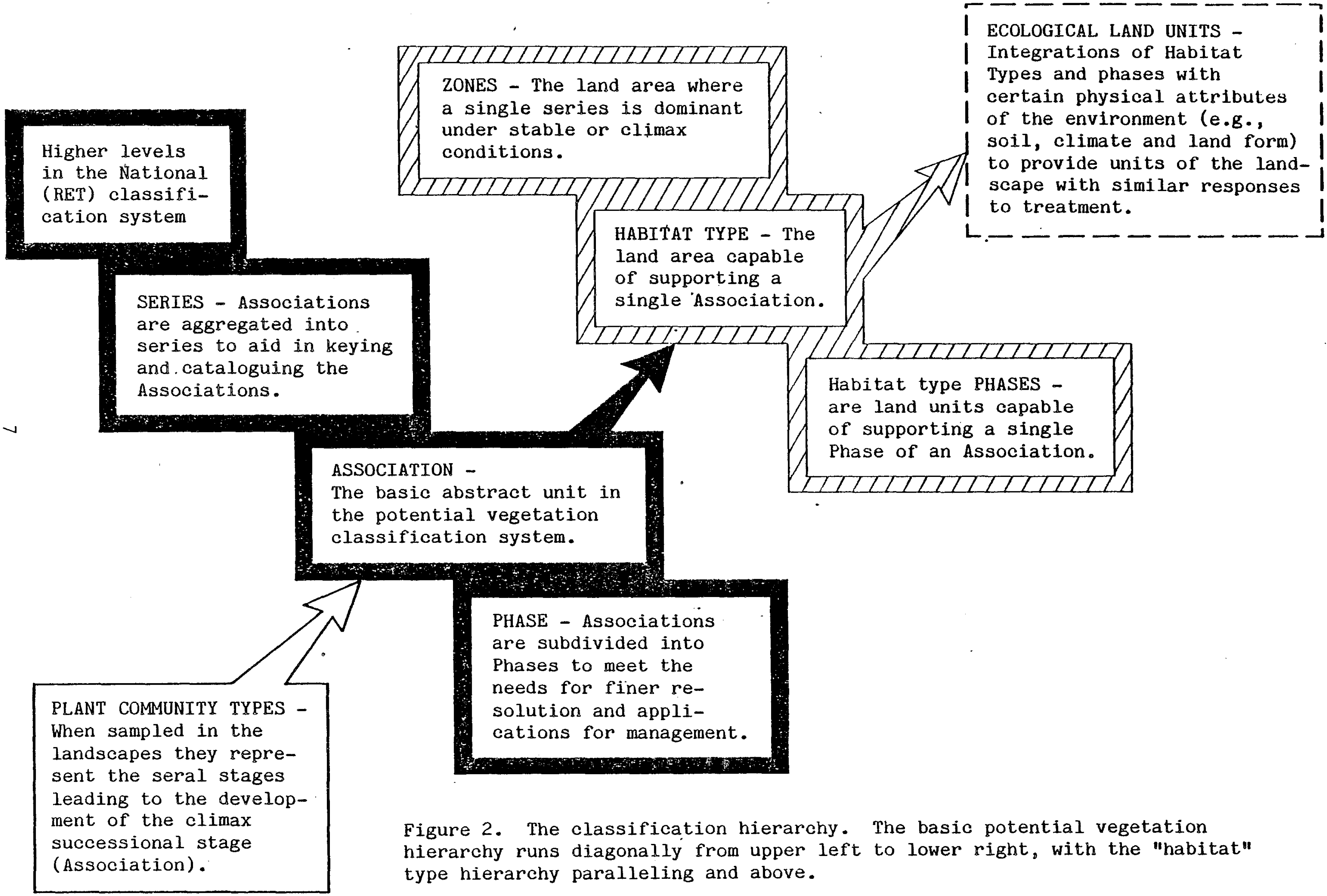

Figure 2. The classification hierarchy. The basic potential vegetation hierarchy runs diagonally from upper left to lower right, with the "habitat" type hierarchy paralleling and above.

FIRE HISTORY

At least four and possibly as many as eight major fires, each burning at least 10% of the area, have burned through the Shelton District in the past 750 years (Fig. 4). This fire history has been concentrated in the easterly section where records show that a major crown fire has burned most of the area at least every 134 years. Most of the old-growth in this area, however, originated following a fire ca. 1668 A.D.

Fires apparently burned the area in (1249), 1309, (1379), 1442, 1497, (1617), 1668, (1720); years of apparently minor fires or fires whose evidence has been largely destroyed are given in parentheses. The major fires (i.e. 1668, 1497, 1442, and 1309) each burned at least 30% of the District and apparently covered extensive areas east and south of the area as well.

Remnants of a forest which originated ca. 1249 A.D. apparently survived a tremendous fire ca. 1309 A.D. (about 672 years ago). Fourteen stands averaging 653 years in age originated following this fire. No fire scars are known to date this fire, therefore, the age of 1309 is approximate. This fire is believed to have burned 110,000 acres or 80% of the District. Such a fire must have burned under extraordinary conditions which have apparently not been repeated since.

Some evidence for a fire about 1379 exists near Spider Lake. Whether this is a small part of a large fire, whose evidence has been mostly eliminated or simply a small fire during that time is still not known. I believe it is most likely a small fire whose evidence has survived to today.

Another large fire burned ca. 1442 through most of the eastern portion of the District, setting up a pattern that persisted through several reburns. This fire is dated by 7 fire scars averaging 535 years b.p. with the modal value at 539. About 55,000 acres (22,300 ha.) burned at this time or about 41% of the District.

Only 55 years later ca. 1497 another fire reburned most of this area. This fire is dated by 5 fire scars (modal age = 484 b.p.) and a few trees averaging 477 years old. There is some evidence that about the same area reburned again ca. 1617 A.D. (369 years ago). Four fire scars around Spider Lake give the suggestion of this fire.

Most of the old-growth in the S. Fk. Skokomish drainage originated following a fire ca. 1668 A.D. which apparently reburned much of the original area burned in 1442. Stand ages in this area generally run between 250 and 313 years b.p. However, another fire ca. 1720 reburned parts of this area again, further obliterating the historical evidence and complicating the stand age pattern.

For the interval 1249 to 1720 A.D. substantial portions of the area burned every 120 years, with a fire of a significant enough impact to have left some evidence occurring every 67 years. After about 1720 A.D. a different fire pattern is revealed with only a 5,000 acre fire ca. 1838 (1849?) occurring in this nearly fire-free period.

The regularity of the burns from 1249 to 1720 is also interesting. Only 60 years passed between the start of the fire history in 1249 until the first good fire evidence in 1309, thereafter, a fire of at least 5,000 acres (2000 ha) occurred somewhere on the District at these intervals: 70, 63, 55, 120, 51, 52, 118, 142 years.

Three variables appear to be related to the occurrence of these past fires. First, each of the confirmed major fires, i.e. about 1309, 1442, 1497, and 1668, occurred during prolonged sunspot minima. The first occurred during the Wolf sunspot minimum (ca. 1280 to 1350 A.D.), the second and third occurred during the Sporer sunspot minimum (ca. 1420 - 1530 A.D.) and the last occurred during the Maunder sunspot minimum (ca. 1645 - 1715 A.D.) (Stuiver and Quay 1980).

Secondly, the recent historical evidence (Morris 1934) indicates that years of large fires such as 1849, 1902, 1934, were characterized by extreme drought and dry east winds. It could be assumed that these same two conditions coincided with the major fires of the past. Using the results presented by Keen (1937), an attempt was made to correlate past fires with Keen's presumed drought years form eastern Oregon. A weak relationship is revealed at best. Further investigation is needed to determine if this kind of inference (Keen's droughts) is justified.

Lastly, and not insignificantly, fires appeared to burn more frequently in young (i.e. less than 100 year old) regrowth. The burn-reburn phenomenon; clearly shown in the Yacolt, Tillamook and Forks burns, also appears to have been prevalent in pre-historic times. During the interval 1249 to 1497 parts of the Shelton District may have been reburned as many as four times, with young intertwined tree canopies plus residual fuel from the previous burn creating extremely hazardous fuel conditions. Again from 1617 to 1720 parts of the eastern sector may have burned three times with an interval of about 50 years between burns.

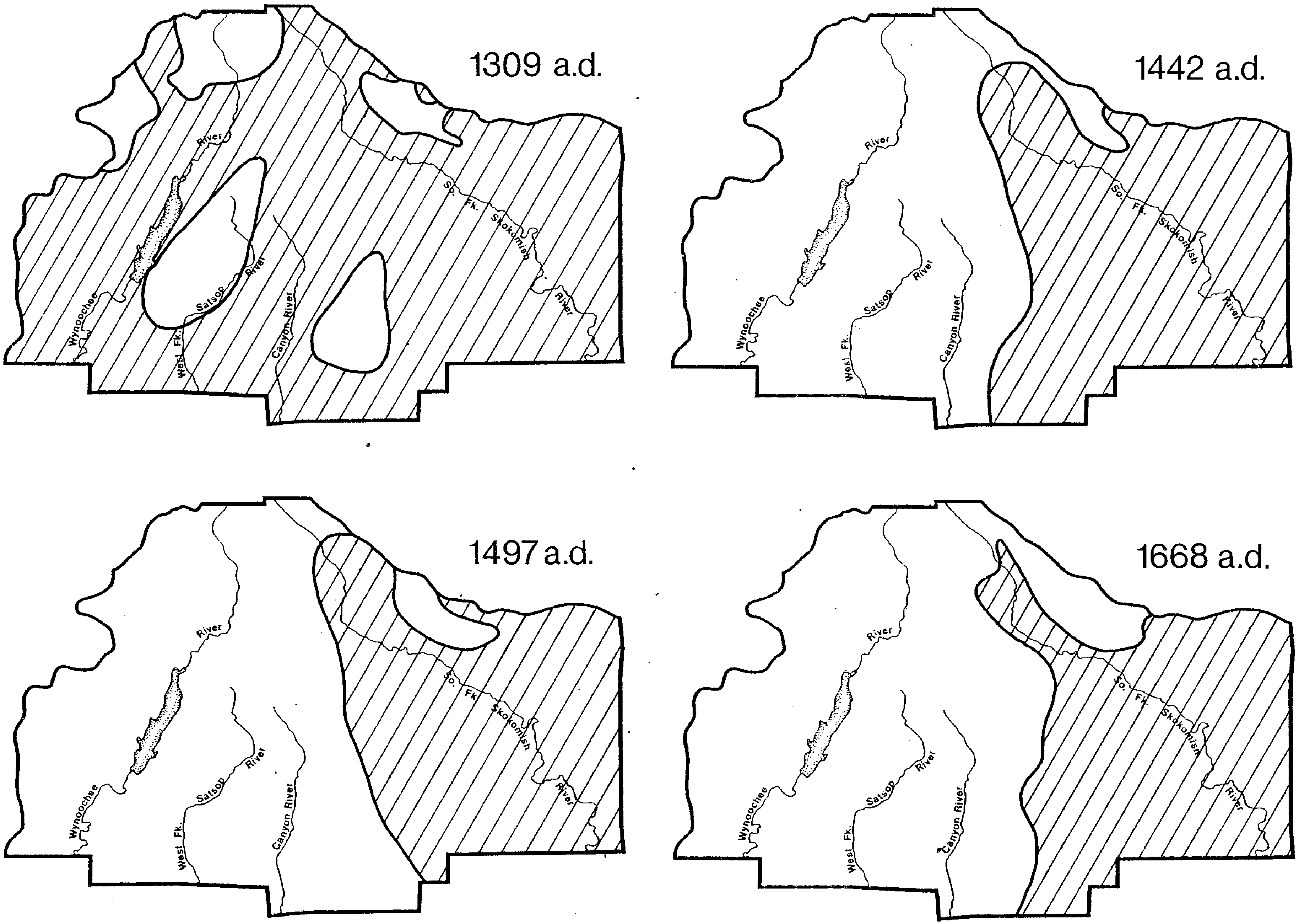

Figure 4. The four major burning episodes on the Shelton District in the past 700 years. The earliest documented fire ca. 1309 a.d. burned most of the district. The last ca. 1668 a.d. burned most of the eastern half.

SAMPLING PROCEDURES AND ANALYSIS

The vegetation was sampled using 500 m^2 reconnaissance plots. These plots were used to acquire data on vascular plant species presence and cover. The taxonomic authority used was Hitchcock et al. (1955-1969). Hitchcock and Cronguist (1973) was used for field identification. Data were also taken on the physical site features (slope, aspect, elevation, and topography) plus measures of stand structure, age and productivity. Plot locations were marked on topographic maps. Details of plot layout, coverage estimates and parameter codes are not presented here, but are available on request. In general, they follow the procedures used by Henderson 1974, Henderson et al. 1979, Franklin et al. 1979, and discussed in Franklin et al. 1970, and Henderson 1979.

Sampling was done to provide an adequate coverage of all areas, stand ages and vegetation types at an intensity of at least one plot per section of land (Figure 5). To do this, several sampling strategies were used. Initially, we tried to put one plot near the center of each section of land where road or trail access allowed. Since sampling of old-growth communities was the primary objective, often the most accessible stand of old-growth near the center of a section was used.

Where this sampling scheme was not feasible, road, trail or cross-country transects were used with a predetermined sampling interval (e.g., each 1/2 mile, 1/2 hour, or 300 feet elevation). Lastly, if this did not prove appropriate for the vegetation at hand, subjective bias was used to allow sampling of communities too small or irregular to be picked up in the other strategies. Also, plots were often established in clusters (most often as pairs) when it would be useful for subsequent analysis to show, for example, the vegetation on two or more contrasting aspects or to sample two or more different age classes contiguous or near enough to each other to represent the same kind of site.

The resulting sample of 212 plots on the Shelton District (including 119 old-growth forest plots, 14 non-forest plots and 79 seral forest plots) represents a combination of systematic and subjective sampling strategies. The objective was to ensure optimum representation in the samples of the variability in vegetation in the District. This provided us with a sampling intensity of 1.1 plots/section.

Identification of plant Associations used computer assisted sorting and clustering routines Volland and Connelly (1978). Only old-growth and climax communities were used in this analysis. Association and similarity tables and cluster analysis dendrograms were generated to help group climax communities and projected climax communities into types. Each type being comprised of and characterized by communities with relatively homogeneous composition. Although several different approaches are used, and each one aggregates plots into clusters or types, they ordinarily do not completely agree. The final marrying of approaches becomes subjective and controlled largely by the biases and perspectives of the classifier. However, the objective is a classification of climax community types (Associations) with the greatest overall within class similarity and the greatest between type dissimilarity.

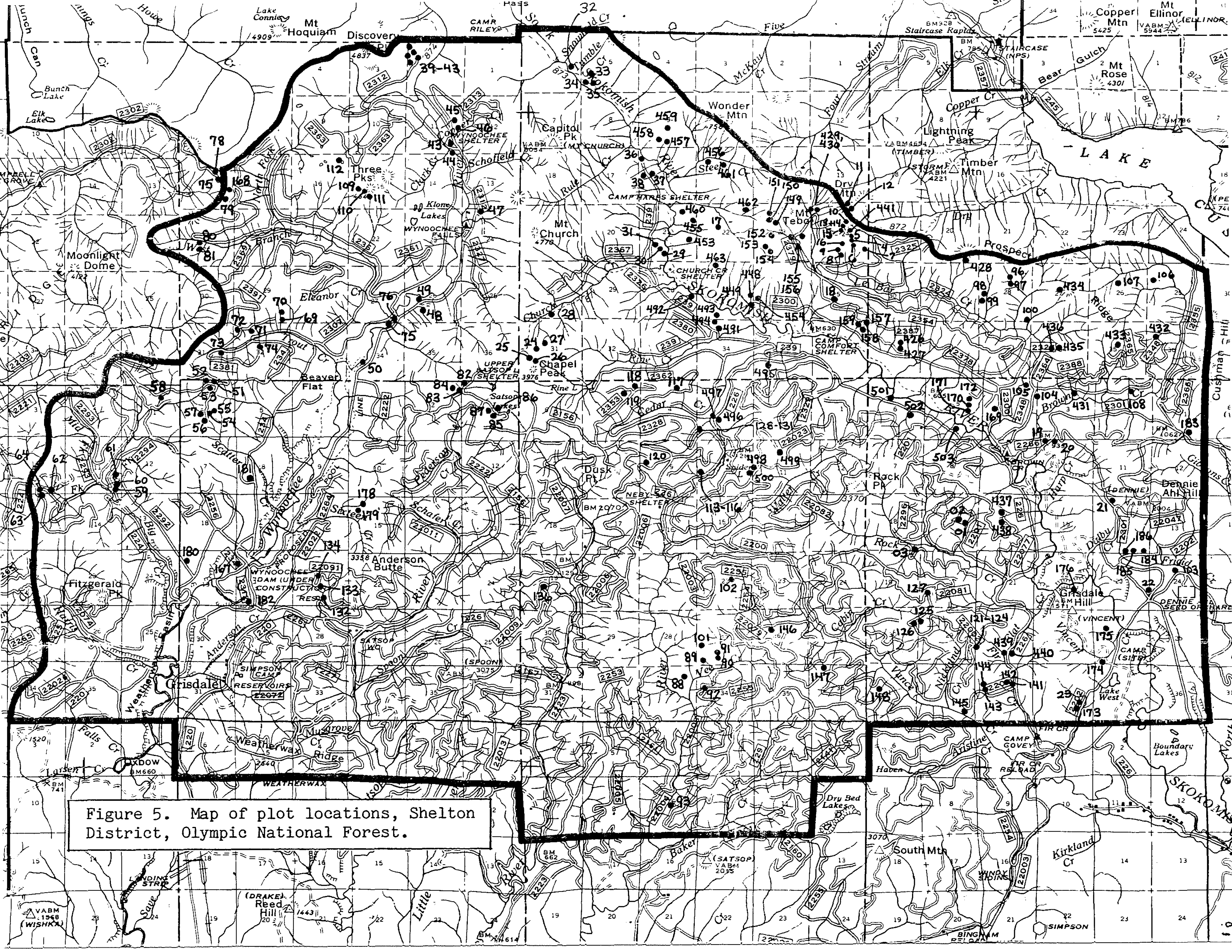

Figure 5. Map of plot locations, Shelton District, Olympic National Forest.

THE FOREST SERIES

The first level in the classification hierarchy below the regional formation or biome is the series. It is also the first level that is useful at the forest planning or project level.

Series are broad units of the potential (projected climax) vegetation which are identified by one (or more) dominant overstory species. On the Shelton District we recognize four series - Douglas-fir, western hemlock, silver fir, and mountain hemlock. The area of ground where these series represent the dominant potential vegetation are called zones and go by the same names, i.e. the Douglas-fir zone is the area where the Douglas-fir series is potentially dominant etc.

Typically, in the near-climax state in temperate forest vegetation more than one tree species dominates. This is understood even when we use a single tree species name to identify a series. For example, in the silver fir series western hemlock and silver fir will codominate. In the mountain hemlock zone, silver fir or yellowcedar will codominate with mountain hemlock. The distribution and location of the western hemlock, silver fir and mountain hemlock zones are shown in Figures 6 and 7.

The first step in identifying an Association or habitat type is to identify the series. The series name becomes the first part of the name of Association or habitat type just as the genus is the first part of the species name in plant taxonomy.

The following key will allow the user to identify the series. It can only be used on stands or communities for which the projected climax composition is known or can be estimated.

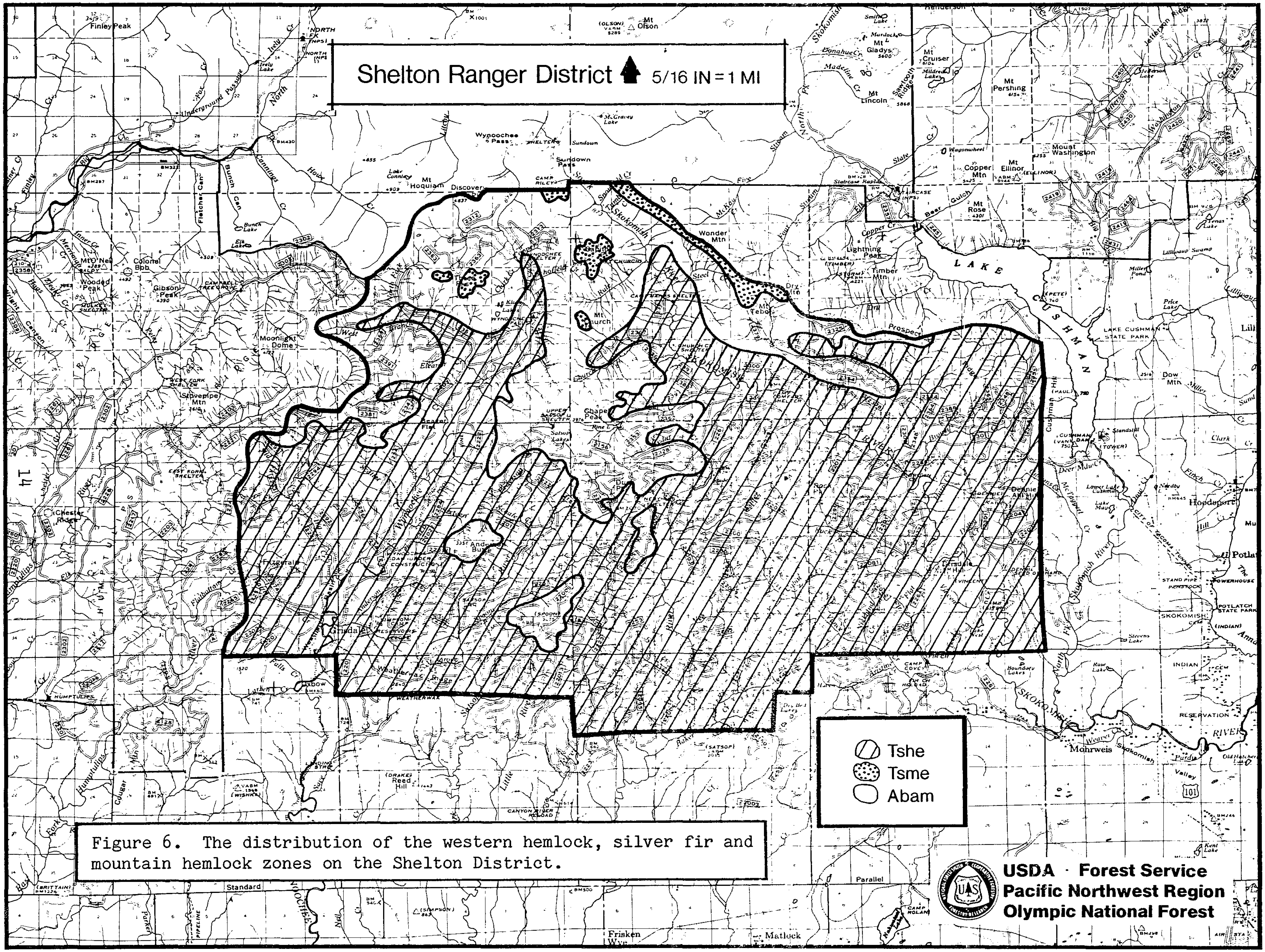

Figure 6. The distribution of the western hemlock, silver fir and mountain hemlock zones on the Shelton District.

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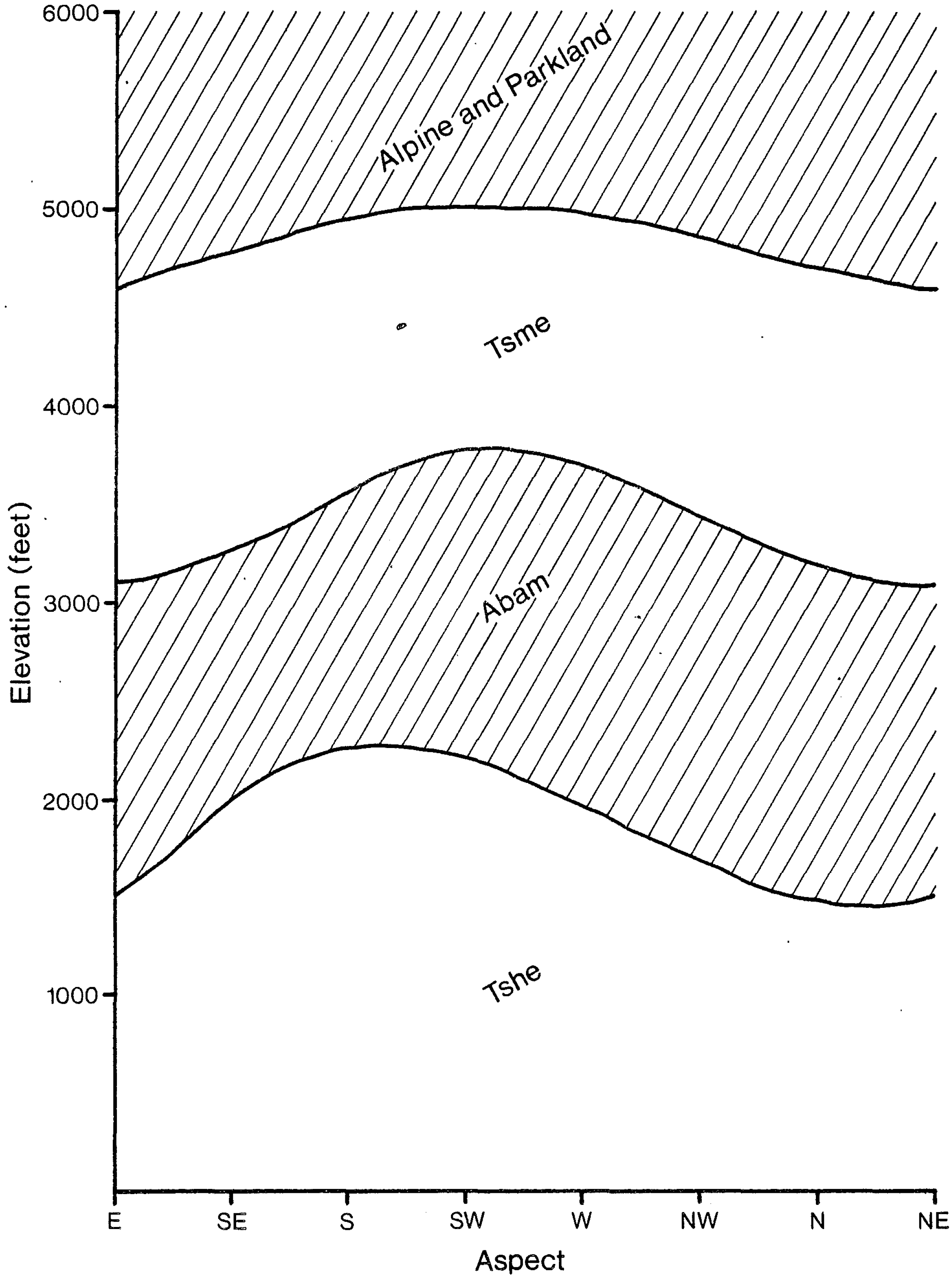

Figure 7. Distribution of major series (zones) by aspect class and elevation, Shelton District, Olympic National Forest for zonal habitats (i.e. stream bottoms and rock outcrops excluded).

Key to the Forest Series[1]

1. Mountain hemlock $\geq$ 10% cover .... Tsme[2] Series p. 17

1. Mountain hemlock $<$ 10% cover, or seral..... 2

    2. Silver fir $\geq$ 10% cover................. Abam Series p. 25

    2. Silver fir $<$ 10% cover................. 3

        3. Western hemlock $\geq$ 10% cover........ Tshe Series p. 34

        3. Western hemlock $<$ 10% cover
        Douglas-fir dominant............... Psme Series p. 50

[1]This key applies only to communities in the projected climax condition. Therefore, only tree species able to compete in the climax condition are used. When a species can be seral on one site and climax on another, care should be taken to recognize the proper successional character of the species.

[2]These abbreviations include: Tsme = *Tsuga mertensiana* (mountain hemlock); Abam = *Abies amabilis* (silver fir); Tshe = *Tsuga heterophylla* (western hemlock); Psme = *Pseudotsuga menziesii* (Douglas-fir). See Appendix (p. 57) for list of common plants and their abbreviations.

Tsuga mertensiana (Mountain hemlock, Tsme) Series

The mountain hemlock Series is found sporadically above about 3200 feet (975 m) on northerly aspects and 3800 feet (1160 m) on southerly aspects mainly around Capitol Peak, Three Peaks and the Wonder Mountain-Mt. Tebo area (Figure 6).

The mountain hemlock Series is characterized by high precipitation and cold maritime temperatures which result in a deep and long-lasting winter snowpack. Precipitation generally exceeds 100 inches (254 cm) (Table I) in this zone and falls mostly as snow or cold rain during the winter season. Because of this precipitation pattern, moisture is generally amply available, except on extreme topoedaphic situations where excess drainage may occur. Water is sometimes limiting in the excess where topographic features allow soil water to accumulate (bogs, springs, stream channels).

The temperature regime here is probably a more significant environmental factor than the moisture pattern, except perhaps for the physical forces of the heavy snowpack itself. Cold soils due to the lower ambient air temperature and the depth and lateness of the snowpack probably precludes many lower elevation species here. Summer soil temperatures at a depth of about 20 cm (5") seldom get above 12°C (54°F). This upper zone of the soil is maintained at near-freezing temperatures by the insulating effects of the snowpack throughout the winter, and warm very little until the snowpack is gone. Then there is a rise in soil rooting zone temperatures until cool rains resume in the fall. This short period of time of soil warming is a significant ecological factor in the Tsme zone. In addition to the cold soil temperatures in the rooting zone, the effect is compounded by the occasional high soil surface temperatures on unshaded and darkened surfaces. This contrast in soil temperature within only a few centimeters is a very harsh environment for plants to germinate and become established.

Soils are variable, but generally typical of high mountainous areas. They are mostly developed from steep, shallow and unstable colluvium or remnants of alpine glacial till.

Due to the short growing season and cold temperatures, timber stand growth and tree re-establishment (succession) following disturbance, are generally quite slow. The mean tree height (based on silver fir or mountain hemlock) expected at age 100 years was calculated to be 77.4 feet (23.6 m) and a range from 58 to 98. This is based on tree age, however, and not total stand age. Since there is often a long establishment period following disturbance of 30 to 150 years in this zone, and often very suppressed height growth in the early years, this may represent a substantial overestimate of what might be achieved starting from the time of disturbance. Basal area for these same stands (ca. 550 years estimated ages) average 228 ft^2/ac (52 m^2/ha) with a range from 165-300 ft^2/ac (38 - 69 m^2/ha).

Three Tsme Associations are identified based on sampling. One additional Association is listed and included in the key and is likely to be found, but was sampled only outside the area.

TABLE I. Weather Stations in the Mountain Hemlock Zone.

		TEMPERATURE			PRECIPITATION	
STATION	ELEVATION	AVE. ANNUAL	AVE. JANUARY	AVE. JULY	AVE. AMOUNT	SNOWFALL
Stevens Pass	4085' (1245 m)	39.3°F. (4.1°C.)	23.4°F. (-4.8°C.)	56.3°F. (13.5°C.)	75.55" (1919 mm)	
Snoqualmie Pass	3020' (920 m)	41.8°F. (5.5°C.)	26.3°F. (-3.2°C.)	57.8°F. (14.4°C.)	107.6" (2733 mm)	387" (982 cm)
Mount Baker Lodge	4469' (1362 m)	40.1°F. (4.5°C.)	27.3°F. (-2.6°C.)	53.8°F. (12.1°C.)	111.1" (2821 mm)	550" (1398 cm)
Paradise Ranger Station	5975' (1821 m)	38.1°F. (3.4°C.)	25.9°F. (-3.4°C.)	52.9°F. (11.6°C.)	103.7" (2635 mm)	536" (1362 cm)
Stampede Pass	3978' (1206 m)	39.9°F. (4.4°C.)	23.7°F. (-4.6°C.)	56.9°F. (13.8°C.)	93.60" (2377 mm)	

1 These stations are near the mountain hemlock zone, but in the silver fir zone. They are included for reference.

Key to the Associations in the Tsme Series

1. White rhododendron (Rhal) ≥ 5% cover................Tsme/Rhal p. 20

1. Not as above..................... (2)

 2. Alaska huckleberry (Vaal) ≥ 10%.................Tsme/Vaal p. 21

 2. Not as above................. (3)

  3. Thinleaved huckleberry (Vame) ≥ 10%.........Tsme/Vame p. 22

  3. Plot does not key. The problem is 1) Depauperate understory i.e. less than 10% total understory cover. Return to lead 1 and use relative cover instead of absolute cover; or 2) community sampled is not in stable or near-climax condition. Project the community composition through time to obtain an estimate of the projected climax composition for the community, then return to lead 1; or 3) community is not properly identified as belonging to the Tsme series; or 4) unrecognized or an unclassified Association for this area.

Tsuga mertensiana/*Rhododendron albiflorum* (mountain hemlock/White rhododendron, Tsme/Rhal) Association.

Two plots were sampled in the vicinity of Mt. Tebo. Dominant trees on these plots averaged 575 years old and 79 feet (24 m) tall (Table II). Basal area averaged 165 ft^2/ac. (38 m^2/ha) and reconstructed dominant tree height averaged 26 feet (8 m) at 100 years. These two plots ranged from 3700 to 4480 feet (1125 - 1365 m) elevation and occurred on moderately steep (59%) slopes on northerly aspects. This represents one of the least productive habitat types in this area, only yielding 9 ft^3/ac./yr. over a 100 year rotation.

The shrub component of the understory layer was dominated by *Rhododendron albiflorum* (Rhal) with *Vaccinium membranaceum* (Vame) always present and sometimes codominating. Seral remnants, *Phyllodoce empetriformis* (red mountain heather) and (*Vaccinium deliciosum* (Cascades huckleberry) were present in some stands. The generally sparse forb layer was often dominated by *Rubus pedatus* (Rupe) (Table III).

Timber management opportunities on the Tsme/Rhal h.t. are essentially non-existent. Silviculturally this type represents a substantial challenge. Because of the tremendous lag in regeneration and extremely slow growth the first 100 years following clearcut or wildfire probably would not yield any usable timber volume at all. On the other hand, watershed protection and recreation values are relatively high.

The Abam/Rhal h.t. is recognized by Franklin et al. (1979) in Mount Rainier National Park. Their data indicate that Tsme is a major codominant, thereby making their Abam/Rhal comparable to the Tsme/Rhal type in this report. The "mixed" Forest of Del Moral (1973) for Findley Lake basin is also comparable to the Tsme/Rhal Association.

Tsuga mertensiana/Vaccinium alaskaense (Mountain hemlock/Alaska huckleberry, Tsme/Vaal) Association.

Two old-growth plots were sampled in the Upper Wynoochee which form the basis for recognizing this Association here. This type is also known from the Upper Hoh (Henderson et al. 1979) and from the Mount Baker-Snoqualmie National Forest (Henderson and Peter 1981), Franklin et al. 1979 do not recognize this type, but some stands included in their Abam/Vaal Association appear to have enough Tsme to be considered comparable to the Tsme/Vaal Association as recognized here. The two communities sampled were estimated to be 450 and 700 years old, but could be much older. Both communities occurred within 40 feet (12 m) elevation of each other, on comparable aspects (SE) even though on different mountains.

In some senses this type could be interpreted as the upper elevational range of the widespread Abam/Vaal type (may be the Abam/Vaal (-Tsme phase)). When recognized it is usually the warm (low elevation, southerly aspects) portion of the Tsme zone. Either way it should be recognized as somewhat of a transition between the Abam zone below and the Tsme zone above.

Top heights averaged 135 feet (41 m) with an expected height at 100 years of 69 feet (21 m) based on preliminary local height growth curves Table II. Basal area averaged 255 ft^2/ac. (58 m^2/ha).

Vaccinium alaskaense (Vaal) was clearly dominant in the communities sampled, averaging 40% cover. Vaccinium membranaceum was present in both communities averaging 10% cover, Table III. Xete, Phem, Vade, Clun and Rupe also were present, although forbs in general were conspicuously low in cover.

Because of the harsh environment in the Tsme/Vaal h.t. silvicultural options are severely limited, natural regeneration following cutting or fire is quite slow. It is reasonable to expect the seral shrub (mostly Vaccinium spp.) dominated stages to persist for about 100 years before conifers reasonably reclaim the site.

Tsuga mertensiana/Vaccinium membranaceum (mountain hemlock/thinleaved huckleberry, Tsme/Vame) Association.

One old-growth plot was sampled on a southwest slope on Mt. Tebo which represents this type in this area. It was aged at 530+ years and had a dominant top height of 118 feet (36 m) and an expected dominant tree height at 100 years of 51 feet (16 m) (Table II). Basal area was 300 ft^2/ac. (69 m^2/ha).

It is expected to occur at higher elevations than Tsme/Vaal, but on drier slopes and exposures than Tsme/Rhal but not as dry as Tsme/Xete, to which it is most closely related. Del Moral et al. (1976), sampled 14 stands in the middle fork of the Snoqualmie drainage which they recognized as the Tsme-Abam/Vame-Mefe community type which would likely belong to the Tsme/Vame Association. The "mixed conifer" and "Tsuga" community types presented by Del Moral for Findley Lake Basin (1973) bears some resemblance to Tsme/Rhal and Tsme/Xete respectively, while Vame is an important codominant in these "types". Del Moral and Long (1977) recognize an Abam/Vame-Vaov community type in the Cedar River drainage which is comparable to stands classified as Tsme/Vame elsewhere. In Mount Rainier National Park Franklin et al. (1979) do not recognize a Tsme/Vame habitat type, however, their stands recognized as representing the Abam/Rula, Abam/Rhal h.t.s and some of the stands in the Abam/Mefe type are clearly dominated by Vaccinium membranaceum and codominated by Tsme (Table III). Also, their Abam/Xete type has some Tsme and considerable Vame indicating that some of their stands in this type may also belong to Tsme/Vame. The above habitat types (i.e. Associations) that Franklin et al. (1979) recognized, I prefer to recognize as phases of the broader Tsme/Vame and Abam/Vame Associations.

Table II. Environmental and physical values for Associations in the *Tsuga mertensiana* (mountain hemlock) Series.

	Tsme/Vaal (n=2)	Tsme/Rhal (n=2)	Tsme/Vame (n=1)
Aspect	SE	N	SW
Slope (%)	40	60	25
Elevation (Ft)	3620	4090	3980
Top height (Ft)	134	79	118
Basal Area (Ft^2/ac.)	255	165	300

Table III. Average coverage values for the Associations in the <u>Tsuga mertensiana</u> (mountain hemlock) Series, Shelton District.

	Tsme/Vaal (n=2)	Tsme/Rhal (n=2)	Tsme/Vame (n=1)
TSHE			10
ABAM	75	32	77
TSME	19	44	15
CHNO	5	3	
PIMO	•		
BENE			2
VAOV	4	5	
VAAL	40	25	8
MEFE	•		
VAME	10	10	30
SOSI			
PHEM	2	2	
RHAL		25	
VADE	2		
ACTR			3
BLSP	•	•	
CLUN	•		2
RUPE	•	23	
STRO	•		
RULA			
XETE	4	•	15
LUPE		•	
ERMO	1	12	
GAOV	•		

Abies amabilis (Silver fir, Abam) Series.

The Abies amabilis (Abam or silver fir) series represents about 30,000 acres (12,000 ha) or about 23% of the District. A total of 53 plots have been taken in the Abam zone, of which 43 represent old-growth communities.

Four Associations are recognized from the data, the Abam/Gash, the Abam/Vaal, the Abam/Stro, and the Abam/Oxor. In addition the Abam/Bene and Abam/Opho habitat types are anticipated but not sampled in old-growth condition.

The Abam series occurs on the cooler, mid-elevation slopes and moist stream bottoms. On the slope it occurs from about 1500 feet (450 m) on north aspects to 2300 feet (700 m) on south aspects up to 3000 feet (900 m) on north aspects to 3800 feet (1160 m) on south aspects (Figure 6). In stream bottoms it occurs down to about 1200 feet (365 m).

The Abam zone is characterized by cool moist soils, persistent winter snowpack, a general lack of summer plant water stress and a short cool growing season. Mean annual temperature in this zone (based on data from the Cascades) is between 5-7°C (41-45°F) while the warmer Tshe zone averages 10.1°C (50.2°F) and the colder, snowier Tsme zone ranges from 3-5°C (37-41°F). Precipitation in the Abam zone is over 140 inches (356 cm) annually with much of it coming as snow and persisting on the ground until April at the low elevations and June at high elevations. These climatic factors result in a much longer fire return period than the Tshe zone.

Wildlife values in the Abam zone are lower than the Tshe zone which provides most of deer and elk winter range and the Tsme zone which provides mainly summer range. The Abam zone can provide much of the summer runoff and is therefore important hydrologically because of the delayed discharge. The Abam zone in general provides considerable dispersed recreation activity and is important as an esthetic backdrop to many scenic vistas.

Key to the Associations in the *Abies amabilis* (Silver fir, Abam) Series.

1. Alaska huckleberry (Vaal) $\geq$ 10% . . . . Abam/Vaal p. 27

1. Vaal $<$ 10% . . . . (2)

    2. Salal (Gash) $\geq$ 10% . . . . Abam/Gash p. 29

    2. Gash $<$ 5% . . . . (3)

        3. Oxalis (Oxor) $\geq$ 10% . . . . Abam/Oxor p. 30

        3. Not as above . . . . (4)

            4. Rosy twistedstalk (Stro) $\geq$ 5%, Titr, Actr and other forbs also conspicuous . . . . Abam/Stro p. 31

            4. Not as above, either a depauperate community (return to lead 1 and use relative cover instead of absolute cover) or community sampled in disturbed or seral condition or undescribed Abam Association for this area. (Abam/Bene and Abam/Opho might be expected.)

Abies amabilis/Vaccinium alaskaense (Silver fir/Alaska huckleberry, Abam/Vaal) Association.

The Abies Amabilis/Vaccinium alaskaense Association is the most common component of the old-growth vegetation in the Shelton District. Its landscape counterpart, the Abam/Vaal habitat type, is the commonest component of the land, accounting for about 20% of the total area. This is not atypical for western Washington as it is possibly the commonest habitat type throughout this area.

The Abam/Vaal Association in its mature (i.e. climax state) is codominated by Abies amabilis and Tsuga heterphylla in the tree layers. Vaccinium alaskaense is typically the dominant species in the ground layers. Vaccinium ovalifolium, Berberis nervosa, V. membranaceum, Acer circinatum, Linnaea borealis, Cornus canadensis, Clintonia uniflora, Blechnum spicant, Streptopus roseus, Rubus lasiococcus, Rubus pedatus and Xerophyllum tenax are commonly encountered in at least some phases of this association (Table V).

Thuja plicata is often a minor component of the tree layer. This species reproduces very slowly and infrequently throughout much of its range. It maintains itself here by virtue of its tolerance to shade and longevity. Chamaecyparis nootkatensis and Tsuga mertensiana are somethimes encountered in minor amounts in the cooler, wetter portions of this type. Pseudotsuga menziesii is at least codominant in the tree layer for the first 200 years but yields to Abies and Tsuga after about 300 years. Because of the longevity of the species, however, individuals will persist in the stand for at least 700 years, and perhaps for as long as 1100 years in some areas.

The Association indicator, Vaccinium alaskaense, appears to dominate the site within the first 10 years of succession, although this is an average for the type and may take less time under a light or no burn condition, or longer with a more severe ground fire or broadcast burn.

The number of sampled stands in the 400-700+ year age class reemphasizes the belief that the natural fire history in the Abam/Vaal h.t. is one of fewer, probably more severe fires throughout recent history (last 2000 years). These sites being cool and well watered, are believed to be less able to carry wildfire. For this reason it could be considered when looking for natural fire breaks. Likewise, slash disposal by burning might be considered less critical here than in other types.

Timber productivity is moderate to low. Data from inventory plots for old-growth stands on this habitat type contain 7333 ft^3/ac. (40,000 bd. ft./ac.). Yield capacity tables from McArdle and Meyer (1930), however, indicate that for pure Douglas-fir stands at lower elevations about 10,000 $ft.^3$/ac. is attainable in about 160 years (for SI 105 and BA 277 ft^2/ac.). Maximum net volume probably occurs about 400 years and culmination of mean annual increment (from Curtis et al. 1973) is around 150 years. Yield at culmination of MAI is probably about 10,000 ft^3 although better yield data are badly needed for middle and upper elevation mixed stands.

Average site index using McArdle and Meyer's (1930) curves for 11 old-growth stands (with Douglas-fir in them to use as site trees) was 123 (base 100). The mean top height curve based on a hand-fit curve using 30 data points intercepted 100 years at 89 feet (Table IV). A mean dominant tree height of about 89 feet at 100 years is a reasonable expectation for the Abam/Vaal h.t. Although that may seem low, the height growth continues on for some time not leveling off for several centuries. Basal area appears to peak at about 280 ft^2/ac. by about 300 years.

Silvicultural opportunities exist in the use (or non-use) of fire, in species selection and the use of known seed source. Stocking level may be manipulated somewhat, but probably not to much advantage. Special selection through improvement cutting or cleaning might also enhance yield or quality, but on these sites, this too is unlikely to give significant positive results.

Yield tables and other yield data are conspicuously lacking for this major type. This makes management decisions more difficult.

Wildlife considerations are minor in the Abam/Vaal Association and only slightly higher throughout the various stages of development on the Abam/Vaal h.t. An occasional sign of big game can be seen, mostly in the Opho and Bene phases. Northern spotted owl is found here, mainly, I suspect, because much of the remaining old growth on the Forest is in this type.

Abies amabilis/Gaultheria shallon (Silver fir/Salal, Abam/Gash) Association.

The Abies amabilis/Gaultheria shallon Association develops on sites that could be considered the dry, low elevation extreme within the Abam zone. Abam is a cool moist site indicator occurring at mid-elevations. Gash is a more warm dry site indicator occurring generally at low elevations, below the winter snowpack zone. The two species overlap at the transition on sites that are probably barely tolerable to each species. Silver fir is usually found with low cover, even in old old-growth stands, indicating the marginal site conditions for this species. Salal, however, possibly due to the lack of competition from other species and its ability to reproduce vegetatively may dominate the understory. See Table V for additional species data.

Tree productivity is fairly low (Table IV). McArdle and Meyer (1930) site index averaged 85 feet (26 m). Local height growth curves indicate a dominant tree height of only 69 feet (21 m) at 100 years. Basal area in old-growth stands averaged only 203 ft^2/ac. (46.6 m^2/ac.).

Abies amabilis/Oxalis oregana (Silver fir/Oxalis, Abam/Oxor) Association.

The *Abies amabilis/Oxalis oregana* Association is recognized on the basis of only one plot on the Shelton District. It occurred at 1720 feet (524 m) elevation on a northwest aspect in the Wynoochee drainage. It was a very old stand, Douglas-fir having died out. Productivity indicators are therefore misleading. Top heights were only about 115 feet (35 m). Basal area was 265 ft^2/ac. (61 m^2/ha). Potential productivity is probably fairly high on the Abam/Oxor habitat type in this area. On the Quinault District, where this type is common, top heights averaged 162 feet (49.3 m) in old-growth stands.

Abies amabilis/*Streptopus roseus* (Silver fir/Rosy twisted stalk, Abam/Stro) Association.

The *Abies amabilis*/*Streptopus roseus* Association is recognized on the basis of only one plot on the Shelton District. It occurred at 1700 feet (518 m) on a moist terrace along the upper S. Fk. Skokomish drainage. The dominant tree height was measured at 266 feet (81 m) giving a McArdle and Meyer (1930) site index for Douglas-fir of 180 feet (Table IV). Basal area was 280 $ft^2/ac.$ (64 m^2/ha).

The Abam/Stro h.t. occurs sporadically throughout the moister portions of the Olympics and Cascades, generally on a well-watered, well-drained, rich site that due to topographic position is not cold. Shrubs are nearly lacking with forbs such as Stro, Titr, Actr and Atfi dominating (Table V). See Appendix (p. 57) for an index to species abbreviations.

Table IV. Average physical and environmental variables by Association in the *Abies amabilis* Series.

	Abam/Gash n=3	Abam/Vaal n=33	Abam/Oxor n=1	Abam/Stro n=1
Elevation (Ft)	2133	2588	1720	1700
Slope (%)	63	49	55	0
Aspect (°)	SE	All	N	0
Top height (Ft)	126	154	(162)	266
Basal Area (Ft^2/ac.)	203	248	265	280
Site Index (McArdle and Meyer) (Ft)	85	123	(125)	180
Top height at 100 years, local curves (Ft)	69	89	(84)	158

Table V. Average coverage values for Associations in the Abies amabilis Series, Shelton District. "." indicates a coverage less than one percent.

	Abam/Gash n=3	Abam/Vaal n=33	Abam/Oxor n=1	Abam/Stro n=1
RHPU				
PISI				
PSMEN	18	6	3	20
TSHE	49	37	42	32
THPL	19	3	2	5
TABR	5	.		
ABAM	17	53	56	33
CHNO		4		
TSME		2		
GASH	53	1		
BENE	3	.		
ACCI	11	8	1	2
VAPA	9	3	1	1
VAAL	4	41	7	3
VAOV		2		
MEFE	.	.	1	
RIBR		.		2
OPHO		.	1	2
XETE	2	4		
CHUM	.	.		
BLSP	.	2	4	
POMUM	1	.	20	1
OXOR			40	
TITR	.	2	1	12
ATFI		.	1	5
MADI		.	1	
CHME	.	.		
COLA	.	.	1	
VISE	.	.	1	
TROV2	.	.	1	1
RUUR	.	.		
CLUN		4		1
DRAU2				
DIHO		.	1	
GATR	.	.		
GYDR		.		1
PYUN				
STRO		.	1	8
DISM		.		
ACTR	.	2		7
STAM		.		
COCA	.	1		
TRLA2		.		
SMST	.	.		
LIBO2	6	2		
GOOB	.	.		
VIGL		.		
PYSE	.	.		
ADBI	.	.		1
LICO3	.	.		
LICA3	.	.		

The Tsuga heterophylla (western hemlock, Tshe) Series.

The Tsuga heterophylla (Tshe or western hemlock) series represents about 100,000 acres (40,500 ha) or about 74% of the Shelton District (Figure 5). A total of 136 reconnaissance vegetation plots have been taken in this series, of which 71 represent old-growth or climax condition.

Five associations are recognized from these data, the Tshe/Gash, Tshe/Pomu, Tshe/Oxor, Tshe/Opho and Tshe/Vaal. No other published accounts of plant communities or habitat type classifications are known for this area, although Fonda (1969) worked in similar vegetation elsewhere on the Olympic Peninsula.

The Tshe series represents the lower elevations and warmer sites in this area. It generally occurs up to 2300 feet (700 m) on warm aspects and to 1500 feet (450 m) on cool aspects, but only to about 1200 feet (365 m) in moist draws and stream bottoms (Figure 7).

The climate in the area where the Tshe series predominates (i.e. the Tshe Zone) is characterized by warm temperate, with the beginnings of a strong maritime influence west of the Skokomish drainage. Mean Annual temperature is 50.2° F. (10.1°C) based on four weather stations (Quinault, Quilcene, Elwha and Cushman Dam. Precipitation comes mainly as rain, even in the winter and varies from about 100 inches (25.4 cm) near Dennie Ahl seed orchard to over 180 inches (460 cm) in the Upper Wynoochee drainage (Figure 2). Snow may occur during the winter months, but is, in most years, ephemeral; usually coming and going with the passage of cold fronts. This is in contrast with the Abam Zone where there is normally a continuous cover of snow from December through March at its lower limit and November through May at its upper limit. .

Potential timber productivity is moderate. Site index values based on old-growth stands averaged 126 feet (base 100 years) using McArdle and Meyer's (1930) curves for Douglas-fir (i.e. site class III or IV). Basal area in these same plots averaged 288 ft^2/ac. (66 m^2/ha). See discussion of Tshe/Gash and Tshe/Pomu to compare predicted productivity based on McArdle's site curves and actual height vs. age data for this area. Dominant tree heights at 100 years may only average 111 feet (compared to the predicted height of 126). The difference in expected timber yields at a rotation age of 100 years is 11,368 ft^3/ac. vs. 9,151 ft^3/ac. or only 80% of the predicted yield. These numbers are presented here not at absolutes or even scientifically tested values but rather to indicate that a significant variance from what is now predicted on the basis of McArdle and Meyer's (1930) curves is possible. The precise extent and kind of this error needs to be determined.

Stands in this zone are at least twice as prone to wildfire, as judged by the history of large fires on this district. See discussion of fire history.

The Tshe zone represents most of the ungulate winter range in the Shelton Ranger District and much of the erosion potential during the winter months. Plant moisture stress is considerably higher in the Tshe zone than the Abam zone during the summer drought period (July and August). However, because of the more temperate winter climate and earlier spring, the growing season in the Tshe zone is much longer than the Abam zone - hence the greater timber productivity there.

Key to the Associations in the <u>Tsuga</u> <u>heterophylla</u> Series

1. Devil's Club (Opho) ≥ 5% cover . . . . Tshe/Opho p. 37

1. Opho < 5% . . . . (2)

    2. Oxalis (Oxor) ≥ 10% . . . . Tshe/Oxor p. 38

    2. Oxor < 10% . . . . (3)

        3. Ocean spray (Hodi) ≥ 2% . . . . Tshe/Hodi p. 39

        3. Hodi < 2% . . . . (4)

            4. Salal (Gash) ≥ 10% . . . . Tshe/Gash p. 40

            4. Gash < 10% . . . . (5)

                5. Alaska huckleberry (Vaal) ≥ 10% . . . Tshe/Vaal p. 43

                5. Vaal < 10% . . . . (6)

                    6. Swordfern (Pomu) ≥ 10% . . . . . . Tshe/Pomu p. 44

                    6. Pomu < 10% . . . . (7)

                        7. Vine maple (Acci) ≥ 10% . . . Tshe/Acci p. 47

                        7. Acci < 10% . . . . . . (8)

                            8. Oregongrape (Bene) ≥ 5% . . Tshe/Bene p. 47

                            8. Not as above, either a depauperate community (return to lead 1 and use relative cover instead of absolute cover) or community sampled in disturbed or seral condition or undescribed Tshe Association for this area.

Tsuga heterophylla/Oplopanax horridum (Tshe/Opho) Association.

The Tshe/Opho Association occurs primarily along first, second and third order tributary streams in the Skokomish watershed. It was not sampled in the Wynoochee drainage but should be there. It occurs at elevations from 1000 to 1500 feet (300 to 450 m), on fluvial-alluvial soil material within the narrow stringer-like direct influence zone of a stream. This represents one of the principal riparian habitat types in this area. However, the area covered is probably only about 1%. Total number of species sampled averaged 17 per plot. Tshe/Opho is closely related to the Tshe/Vaal Association.

Oplopanax horridum is normally the dominant understory species. *Ribes bracteosum*, *Acer circinatum*, *Circaea alpina*, *Tiarella trifoliata* and *Galium trifoliata* are common or in some cases, codominant species (Table VII).

The Tshe/Opho Association may be found throughout most parts of Washington's Cascade and Olympic mountains on moist to wet habitats. Franklin et al. (1979) identified the Tshe/Opho h.t. in all major drainages in Mount Rainier National Park. They described it as occurring on a wider range of habitats than on the Shelton R.D. The Tshe/Opho Association is not reported by Del Moral and Long (1977) for the Cedar River drainage. Opho is a component of their Tshe/Vaal community type (Abam/Vaal Association). Franklin and Dyrness (1973) did not recognize this association for Oregon and Washington.

In some areas this association may be difficult to identify, even in old-growth conditions because of the foraging of elk. In such a case Pomu or Vaal will probably dominate the zootic climax communities.

Timber productivity is only moderate despite the apparently good growing conditions. Site index averaged 130 feet (base 100) using McArdle and Meyer's (1930) curves, 108 using local height growth curves (Table VI). Basal area was only 150 ft^2. Stockability, based on preliminary data, is probably only about 0.5. Gross cu.ft. volumes and basal areas were only about 60% of what is predicted for SI 130 from McArdle and Meyer (1930). Gross board feet volumes for two stand exam plots taken by Tom McShane (Brown et al. 1980) were only 1/2 of yield table values for SI 130.

Tsuga heterophylla/Oxalis oregana (Tshe/Oxor) Association.

The Tshe/Oxor Association is represented by two old-growth plots in the Wynoochee drainage where precipitation averages about 180 inches (457 cm) and growing conditions are generally quite favorable. This type becomes a dominant type to the west in the Quinault District.

Two phases are recognized. The Pomu phases by $\geq$ 10% Pomu and the typic Oxor phase. Tshe/Oxor-Pomu is an intergrade to the Tshe/Pomu Association.

Timber productivity on the Tshe/Oxor h.t. is high. Dominant tree heights exceed 200 feet (61 m) in old-growth stands and often reach 250 feet (77 m) (Table VI). McArdle and Meyer (1930) site index was 167 while the estimated dominant tree height at 100 years based on local height growth curves was 144 feet (44 cm).

Because of the gentle slopes, accessibility and its high productivity rates this type represents some of our best opportunities for intensive high yield timber production.

Tsuga heterophylla/Holodiscus discolor (Tshe/Hodi) Association.

This Association represents the intergrade between Tshe/Gash and Psme/Hodi. It represents the dry extreme for Tshe, and some of the lowest productivity sites in the area. The severity of these sites (plus Psme/Hodi) requires extra caution and consideration in implementing any management action. Regeneration will be more difficult and the site will be unforgiving of mistakes. The probable regeneration problems and low timber productivity suggest that long rotations or allocation to uses outside the timber base might be appropriate for these lands.

Only one old-growth plot was sampled in this type. It occurred at 1580 feet (481 m) on a steep south facing slope above the S. Fk. Skokomish river in the vicinity of Camp Comfort (Table VI, VII).

Tsuga heterophylla/Gaultheria shallon (Tshe/Gash) Association.

The Tshe/Gash Association is common in all major drainages on the Shelton R.D. It occurs from the lowest elevations (ca. 700 feet) up to 2500 feet (760 m). The Tshe/Gash h.t. is the commonest in this area occupying over half of the District or about 70,000 acres (28,000 ha). It is perhaps the most common h.t. in western Washington. It occurs primarily on southerly aspects on moderate to steep colluvium but may occur on any aspect if the site conditions are dry. It also occupies most of the lowland till and glacial outwash. This h.t. represents many of the drier sites in this area; only the Psme/Hodi is drier. Precipitation varies from about 100 inches (250 cm) near Dennie Ahl nursery to about 150 inches (500 cm) in the Wynoochee drainage. However, the shallow or well drained soils that characterize this h.t. make it relatively dry. Precipitation comes mainly as rain, although snow may fall and persist for some time following winter storms. The stems of Gash may not be able to withstand the weight of a winter snowpack.

Six phases are recognized in this area. The Libo2 phase, the Pomu phase, the Vaal phase and the Xete phase are indicated by at least 5% cover of these species, the Gash phase is recognized where these indicators are $<$ 5% cover or absent in the old-growth or climax community. The (-Rhma) has Rhma present but less than 10% cover. Only one plot in this area was sampled which fell into this phase.

The Tshe/Gash Association is found throughout the Tshe zone in western Washington. It was recognized by Franklin et al. 1979 in Mt. Rainier National Park on the drier habitats at low elevations, especially in the Ohanapecosh and Nisqually River drainages. Their plots ranged from 1840 and 3300 feet (560 and 1010 m) and occurred on colluvial or well-drained tephras with only weakly developed spodic horizons.

Dyrness et al. (1974) recognized the Tshe/Rhma-Gash Association and the Psme/Acci-Gash community in the central Oregon Cascades. However, they did not recognize the Tshe/Gash Association per se.

Del Moral and Long (1977) report the Psme/Gash community type in the Cedar River which presumably represents a seral stage (38-73 years old) in the development of the Tshe/Gash Association. They indicate it is characteristic of Xeric habitats within the Tshe zone. Their plots in this type did not include Xete.

Henderson et al. (1979) recognized the Tshe-Psme/Gash community type in the Hoh drainage and the Tshe-Psme/Gash and Tshe-Psme/Acci-Gash community types in the Dosewallips drainage. They suggested that these three community types represented seral stages in the development of the Tshe/Gash Association in the Hoh, the Tshe/Acci-Gash and the Tshe-Psme/Gash Associations in the Dosewallips. Their Tshe/Acci-Gash Association probably best represents the typic Tshe/Gash from the Shelton R.D. or an intergrade between Tshe/Gash and Tshe/Acci-Bene. Their Tshe-Psme/Gash with Psme recognized as a co-climax species represents drier habitats than are common in the S. Fk. Skokomish drainage. This may be represented as Tshe/Gash

(-Aruv) phase, Tshe/Gash (-Libo) phase or Tshe/Gash (-Psme) phase. Mostly stands originating in the past 300 years were sampled. The rarity of older stands in the Tshe/Gash h.t. throughout much of its range indicates a significant susceptability to fire. Older stands of Tshe/Gash are encountered in wet precipitation zones along the coast of Washington and Vancouver Island where it intergrades with Pisi-Tshe/Gash.

Spilsbury and Smith (1947) recognized three Gash site types (Gash, Gash-Parmelia and Gash-Usnea) plus the Polystichum - Gash type - an intergrade between Tshe/Gash and Tshe/Pomu.

The successional relationships for the Tshe/Gash h.t. are partially worked out and will be presented for the Tshe/Gash h.t. Twenty five plots representing seven successional stages from "cut but not burned" through "grass-forb" and eventually to near-climax 700 year old Tshe/Gash communities were sampled.

Psme dominates the community within 15 years of burning and planting and maintains dominance of the tree layer until about 400 years when Tshe exceeds Psme. The extrapolated extinction curve for Psme indicates that it will disappear from the community by 800 years.

Gash dominates the ground vegetation within 5 years of burning, largely due to its ability to resprout following fire. Acci is a codominant in these early seral stages but as the overstory canopy closes, it becomes only a minor component of the community, persisting into the near-climax situations by persevering in openings in the canopy.

Pomu is a minor species in the Association but increases following burning to be conspicuous in the early seral communities from 5-25 years old. As the overstory canopy closes about 20 years, it diminishes and remains mostly less than 10% cover into the climax community.

Thpl and Tabr are minor tree components that become noticeable by 300 years and persist into the climax conditions.

The grass-forb and shrub-seedling stages are dominated by residuals from the original old-growth community and a distinctive group of herbs and trailing vines. Senecio sylvaticus (Sesy) is often the most conspicuous species 2 years after burning. Epilobium angustifolium (Epan), Anaphalis margaritacea (Anma), and Rubus ursinus (Ruur) are usually present at this time and assume dominance by 5 years as Sesy passes quickly from the community. See Dyrness (1965, 1973), West and Chilcote (1969) and Corliss and Dyrness (1965) for discussion of early succession on comparable habitats in Oregon.

Except for the change in dominance from Psme to Tshe there is relatively little change in community composition beyond 20 years except when dense, overstocked stands develop which can greatly reduce the understory cover.

An alder pathway such as the one for the Tshe/Pomu h.t. is not recognized. Furthermore, a Tshe dominated conifer pathway does not seem to occur either. The Tshe/Gash h.t. is probably dry enough that only Psme will dominate the early successional stages. This means that silvicultural opportunities for increased growth from cultivating mixed stands or site enhancement through cultivating Alru are low on the Tshe/Gash h.t. in this area. More such opportunities exist in the wetter portions of the area and on the Quinault R.D. where Tshe, Pisi and Alru are more common codominants on this type.

The Tshe/Gash h.t. represents generally moderate site potentials.

Henderson et al. (1979) reported an average top height of 130 feet (40 m) at 250 years for the Tshe/Acci-Gash h.t. in the Dosewallips (i.e. SI=110). They are closely related. Tshe-Psme/Gash averaged only 80 feet (24 m) at 250 years.

Spilsbury and Smith (1947) indicated that their Gash site type would yield a 125 foot Douglas-fir at 100 years, while for their Gash-Parmelia type it was 95 feet and for the Gash-Usnea type it was only 70 feet at 100 years.

Dyrness et al. (1974) indicated that their plots in the Psme/Acci-Gash community type were mostly site class III and IV (i.e. SI 140 and 110).

Henderson et al. (1979) reported 156 ft^2/ac. (36 m^2/ha) at 300 years for the Tshe/Acci-Gash h.t. in the Dosewallips and 141 ft^2/ha (33 m^2/ha) for the Tshe-Psme/Gash h.t.

Spilsbury and Smith (1947) reported 240 ft^2/ac. (55.10 m^2/ha) at 100 years for their Gash site type, and 220 ft^2/ac. for their Gash-Parmelia type.

Franklin et al. (1979) reported an average basal area of 242 ft^2/ac. (55.6 m^2/ha) for a sample of 17 stands in the Tshe/Gash Association in Mt. Rainier National Park.

Overall the average basal area for old-growth stands (300-700 years) on the Shelton R.D. was 286 ft^2/ac. (66 m^2/ha) for the Tshe/Gash h.t., while the average site index for this type is 113 feet (base 100) from McArdle and Meyer. Local site curves indicate an actual height at 100 years of only 102 feet (31 m). Site index 110 from McArdle and Meyer (1930) should yield 287 ft^2/ac. at 160 years. Basal area averaged 286 ft^2/ac. (Table VI).

Wildlife values in this h.t. are moderate. Hiding cover is usually present from the evergreen Gash. Thermal cover is provided by mature and old-growth canopies. Forage production is provided by the herbs in the early seral successional stages, vine maple (Acci) sprouts later and by red huckleberry (Vapa) in mature and old-growth communities. There is some utilization of the fruits of Salal (Gash), Oregon grape (Bene), and trailing blackberry (Ruur) during the summer. This h.t. occupies a substantial portion of deer and elk winter range in this area.

This habitat type appears to burn more frequently than others in the area.

Tsuga heterophylla/Vaccinium alaskense (Tshe/Vaal) Association.

The Tshe/Vaal Association develops mainly on river terraces along third and fourth order streams or on toe slopes adjacent to major streams in the Wynoochee drainage. Soil moisture does not appear to be limiting on these generally cool, but low elevation habitats. Slopes may vary from flat on old river terraces up to 65% on toe slopes or moist sideslopes just below the Abam zone. Elevations were mostly around 1000 feet (300 m), but one plot occurred at 2110 feet (643 m) in the upper Satsop River drainage near Spider Lake. All plots fell within the area of 160 to 180 inches (490-550 cm) precipitation. This type may be more common on the Quinault R.D. to the west.

Three possible phases were encountered, the (-Xete) phase on slopes, the (-Oxor) and (-Vaal) phases on flat terraces or stream bottoms.

The Tshe/Vaal h.t. was recognized in the Hoh drainage by Henderson et al. (1979). They did not report it from the Dosewallips, however.

Franklin et al. (1979) did not recognize it in Mt. Rainier National Park. Dyrness et al. (1974) did not recognize it in the central Oregon Cascades and Del Moral and Long (1977) did not recognize it from the Cedar River Watershed in Washington.

Productivity on this h.t. is moderately high. The site index averaged 153 feet using McArdle and Meyer's (1930) curves and the basal area in two old-growth stands was 319 ft^2/ac. (73 m^2/ha). McArdle and Meyer (1930) predict a basal area of 347 ft^2/ac. at 160 years for SI 160.

Alru is a common seral community dominant on this h.t., which may help explain the high SI and slightly low basal area. Old-growth communities may have reduced stocking due to competition during the mixed conifer-hardwood stages.

Wildlife values on this h.t are high. The huckleberries (Vaal, Vapa) plus Rusp are major forage species for deer and elk.

This type also occupies major portions of water influence zones and elk and deer winter ranges in the Wynoochee drainage.

Tsuga heterophylla/Polystichum munitum (Tshe/Pomu) Association.

The Tshe/Pomu Association occurs in all major drainages on the Shelton R.D. between 700 feet (210 m) and 2350 feet (715 m) on steep (70%) toe slopes on northerly aspects or on gentle slopes along river terraces. Outside of this area it can also be found on steep northerly banks with subsurface water supply and on moderate south slopes in higher precipitation areas. Generally speaking the Tshe/Pomu habitat type represents moist growing conditions (usually due to subsurface water flow), cool summer temperatures (due to aspect or cloud cover) and warm winter temperatures (due to elevation).

Four phases of the Tshe/Pomu Association are recognized. The Tiarella trifoliata (Titr) phase is indicated by at least 10% cover of Titr in the mature and old-growth stages of succession. Titr plus Pomu and Streptopus streptopoides make up at least half of the understory cover (exclusive of mosses) in these communities. Gash, Rusp, Vaal and Blsp are usually present. Three old-growth communities were sampled which fell in this phase. They all occurred along cool toe slopes near first order streams. These habitats seem quite local and probably do not cover much area.

The Acer circinatum (Acci) phase is indicated by at least 10% cover of Acci and/or Bene. Both are often present while Bene is sometimes absent in the very old communities. Pomu averaged 36% cover in 5 old-growth communities sampled. Acci averaged 15% and Bene averaged 9% cover. Ferns, other than Pomu, are generally lacking. Vapa and Actr are often conspicuous in the stand.

The Linnaea borealis phase is indicated by at least 10% Libo2. Three stands ca. 280 years old were sampled in the upper So. Fork Skokomish drainage. They averaged 1567 feet (480 m) elevation, 240 ft^2/ac Basal area with top heights averaging 198 feet (60.3 m) and a site index (McArdle and Meyer 1930) of 170. Local height growth curves, however, give an expected height at 100 years of 145 feet (44.2 m). This phase represents some of the most productive sites on the District occurring on warm, well watered but well drained deep soiled sites.

The Pomu phase lacks the other phase indicator species and generally represents modal site and productivity conditions.

The Tshe/Pomu Association is found throughout the Tshe zone of western Washington. Franklin et al. (1979) in Mt. Rainier National Park identified a Pomu phase and an Abam phase. Their Abam phase is not recognized in the Olympics and their Pomu phase is apparently mostly Pomu-Acci with Gydr and Titr also represented. They found that Tshe/Pomu was restricted to the wetter, western part of Mt. Rainier National Park where it most commonly occurred on moist southerly slopes up to 2800 feet (850 m).

In the Hoh drainage Henderson et al. (1979) reported the Tshe-Psme/Pomu-Oxor community (Tshe/Pomu-Oxor habitat type) and the closely related Pisi-Tshe/Acci/Pomu-Oxor and Pisi-Tshe/Pomu-Oxor communities

(Pisi-Tshe/Pomu-Oxor h.t.). Their Tshe-Psme/Gydr community (Tshe/Gydr h.t.) also has high coverage and constancy of Pomu which indicates it is probably the same as the Tshe/Pomu (-Gydr) Association in the Shelton R.D. Their sampling did not include any plots in the Dosewallips drainage which could be classed as Tshe/Pomu. Their Tshe/Pomu-Oxor Association occurred on southerly sideslopes above the Hoh Valley in similar situations to where Franklin et al. (1979) described the Tshe/Pomu Association in Mt. Rainier National Park. The Pisi-Tshe/Pomu-Oxor and Tshe/Gydr [=Tshe/Pomu-Gydr ? or Tshe/Pomu-Titr] occurred on gentle slopes on the terraces above the Hoh River on similar habitats to the Titr phase in the Shelton R.D.

Spilsbury and Smith (1947) recognized the Polystichum (or sword fern) site type in western Washington and British Columbia.

Dyrness et al. (1974) identified the Tshe/Acci/Pomu, Tshe/Pomu and Tshe/Pomu-Oxor Assocations in the central Oregon Cascades. Their Tshe/Acci/Pomu is the same as Tshe/Pomu (-Acci). Their Tshe/Pomu probably contains the Tshe/Pomu (-Titr) phase and the Tshe/Pomu (-Libo2) phase.

Del Moral and Long (1977) recognized the Psme/Pomu, Psme/Pomu-Libo2 and Alru/Pomu communities in the Cedar River watershed in the Washington Cascades. These seral communities probably include the Tshe/Pomu (-Acci) and Tshe/Pomu (-Libo2) habitat types.

The Tshe/Pomu is generally recognized as a moist, low-elevation habitat type. Of those phases already recognized the (-Oxor) and (-Titr) phases represent the moist segments of the type while (-Acci) and elsewhere in western Washington the (-Libo2) phase represents the drier segment.

The successional relationships for the Tshe/Pomu h.t. are partially worked out. Two basic pathways are recognized. One goes through a hardwood successional stage and the other goes through a conifer stage before culminating in a Tsuga heterophylla climax stage. The hardwood pathway is common on this h.t. due to its favorable growing conditions. Both Alru and Acma may be dominants in this pathway. Tsuga reproduction appears to be retarded by the hardwood successional stage, which can persist until the Alru or Acma die of old age.

Either Psme or Tshe can dominate the conifer pathway. Tshe is more common on the moister phases but Psme is the more common overall. When Tshe comes in early, the climax community can develop in as little as 300 years. Normally it takes over 800 years on this habitat type.

In the hardwood pathway Alru typically dominates the overstory layer for the first 100 years or so, Psme and/or Tshe then takes over dominance. By 300 years Tshe and Psme are codominant and by 700 years Tshe is clearly dominant. Pomu and Acci maintain dominance of the understory layer at all three ages while Bene appears to peak at 300 years and then decline.

In the conifer pathway Psme and/or Tshe codominate at about 35 years with a combined coverage of over 100%. This closed crown situation limits the growth of understory plants so that coverages are low. Pomu still dominates

the understory layer along with some lingering pioneer species such as Ruur. Bene and Acci are usually present in the stand. By 300 years Tshe has assumed a small edge in dominance over Psme. Pomu, Acci and Bene have increased in absolute dominance but have remained about the same in their relative dominance. By 700 years Tshe is clearly dominant in the tree layer and Psme is on its way out. Pomu is clearly dominant in the Herb layer and Acci is conspicuous in the shrub layer. However, Acci is often found in the small openings in the near-climax overstory created by the death of single large old trees. The very early stages in succession on this h.t. have been described by Dyrness (1965).

The Tshe/Pomu represents one of the most productive habitat types in our area. Spilsbury and Smith (1947) list the Pomu as the highest site type in their study. They depict the height-age relationship for this type as reaching 170 feet at 100 years (Site II). Their Pomu-Gash type reached 152 feet at 100 years.

Preliminary data from the Shelton R.D. indicates that dominant tree heights reach 121 feet at 100 years although McArdle and Meyer (1930) predict a site index of 143 (Table VI). The Oxor phase has the highest site index. In the Hoh drainage site index values appear to be more like 170 at 100 years with old-growth tree heights exceeding 240 feet (Henderson et al. 1979). Basal area in the mature and old-growth stands averaged 327 ft^2/ac. (75 m^2/ha) (n=9) McArdle and Meyer (1930) predict a basal area of over 330 ft^2 at 160 years for site index of 140 and 340 for site index 150.

Wildlife values in this h.t. are moderate, at best. Old-growth stands provide thermal cover in summer and winter range in winter for both deer and elk. Most forage production is limited to grass-forb pioneer successional stages following timber harvesting or fire; or early seral Alru dominated communities where the grasses and forbs under the alder will be among the first to green up in the spring.

This habitat type commonly occurs as a component of the Water Influence Zone and therefore has a role in directly affecting stream quality and fish production.

Within the Tshe zone, the Tshe/Pomu h.t. is less likely to burn than most others. Only the Tshe/Opho and Tshe/Vaal have a lower likelihood of burning.

Tsuga heterophylla/*Acer circinatum* (Tshe/Acci) Association

The Tshe/Acci Association develops near stream bottoms in the So. Fork Skokomish drainage, but is not represented by old-growth plots in the sample.

The Tshe/Acci Association is not recognized elsewhere. However, Dyrness et al. (1974) recognizes the Tshe/Acci/Pomu Association and the Psme/Acci-Bene, Psme/Acci-*Whipplea modesta* and the Psme/Acci-Gash communities. The Psme/Acci-Bene and the Psme/Acci Whmo communities may represent the Tshe/Acci Association, but this is not at all clear.

Henderson et al. (1979) recognized the Tshe-Psme/Acci-Bene and Tshe-Psme/Acci-Gash community types in the Dosewallips drainage. Based on data from the Shelton R.D. these communities may represent seral conditions on the Tshe/Bene and Tshe/Gash h.ts.

McArdle and Meyer (1930) site index averaged 125 feet and the basal area averaged 240 ft^2/ac. (55 m^2/ha) in two 140 year old stands which were partially cut.

Successional relations in this tentative type are not known.

Besides understory dominance of Acci and Vapa, the stands sampled had an abundance of Ruur which were fruiting profusely.

Wildlife values in the Tshe/Acci-Vapa communities are relatively high, providing good cover, forage and access to water, especially for winter range.

Table VI. Selected Environmental and Physical Features for Associations in the <u>Tsuga</u> <u>heterophylla</u> Series.

	Tshe/Hodi n=2	Tshe/Gash n=34	Tshe/Pomu n=20	Tshe/Oxor n=2	Tshe/Opho n=1	Tshe/Vaal n=11
Elevation (ft)	1385±20*	1619±55	1538±56	925±4	1250	1578±75
Aspect	S	All	N, E	NW	--	NW, NE
Slope (%)	75	54	59	--	5	25
Top ht. (ft)	120±33	151±31	187±44	230±30	174	197±44
McArdle&Meyer SI	90	113	143	167	130	153
Mean top ht. at 100 years	75	102	121	144	108	126
BA (ft^2/ac.)	150±25	286±75	305±88	240±127	150	319±88
Average age(Yrs)	280±26	384±126	410±213	675±34	300	572±183

* Means ± 1 Standard Deviation.

Table VII. Average coverage values for Associations in the *Tsuga heterophylla* Series.

	Tshe/Hodi	Tshe/Gash	Tshe/Pomu	Tshe/Oxor	Tshe/Opho	Tshe/Vaal
TSHE	4	50	71	96	20	76
PSME	55	46	28	18		21
ABAM		.	.			4
THPL	2	6	8		26	4
TABR	.	1	.			1
CONU	3	.				
ACMA	2	.				
ARME	10					
QUGA	1					
HODI	3					
COCO	3					
ACGL	1	.				
RHMA		.				
GASH	34	65	3	.	1	7
BENE	10	9	8			2
ACCI	22	14	10	14		22
ROGY	1	.	.			.
VAPA	.	9	5	3	1	15
RUSP		.	.	13	4	.
OPHO		.	.		25	
VAAL		1	1	6		23
MEFE		.	.	2		.
XETE	.	4	.			3
COLA	.	.	.	1		.
CLUN		.	.	1		2
COCA		.	.	2		2
GOOB	.	.	.			.
TRLA2	.	.	.		1	
CHUM	2	.	.			.
CHME		.	.			.
HIAL	.	.	.		1	
RUUR	.	.	2			.
VISE		.	.			.
POMU	9	3	23	.	2	2
LIBO2	3	6	3	.		8
ACTR	.	1	2		1	2
TITR		.	3	3	3	2
BLSP		.	2	5	2	2
DISM		.	.	1		.
TROV2	.	.	.	1	1	.
RUPE			.	5		.
ATFI		.	.	1	1	.
OXOR			4	45		
MADI		.		4		.

Pseudotsuga menziesii Series

The Psme series represents the edaphically Xeric sites in the Tshe zone. It is more common in the Olympic rain shadow and the Puget trough but is found sporadically between 1000 - 2000' (305 - 710 m) on steep, rocky or very shallow soil situations, especially in the Skokomish drainage or on excessively well-drained till below 1000' (305 m). Tshe may occur in the climax community up to 10% cover.

Only one association is recognized to date in this series - the Psme/Hodi. However, the Psme/Coco and Psme/Aruv habitat types are known to occur in western Oregon and Washington.

The Psme/Hodi association is recognized on dry sites throughout much of drier parts of the Tshe zone in Western Oregon and Washington. It was recognized as (Tshe)-Psme/Hodi by Henderson et al. (1979) in the Dosewallips drainage in the Olympics and as the Psme/Hodi association by Dyrness et al. (1974) in the Central Oregon Cascades. It was not identified in the Hoh drainage by Henderson et al. (1979); in Mt. Rainier National Park by Franklin et al. (1979) or by Del Moral and Long (1977) in the Cedar River Watershed, Washington.

Site index was estimated at 50 but base 100 using McArdle and Meyer's curve and 36 using local ht. curves.

Tree ages appeared to be considerably younger than known stand ages nearby which indicates either more recent spot fires on this habitat type or a significant lag in regeneration following wildfire. Both are likely. Fire frequency on this h.t. is probably greater than on any other in this area and regeneration problems are expected to be greatest due to the hot, dry sites and shallow easily erosable soils.

Silvicultural opportunities are quite limited on this h.t. Many of the stands on this type will be very difficult to regenerate within 5 years of cutting and burning.

Wildlife values are believed to be low due to the steep inaccessible slopes. However, this type may provide important early spring habitat as the plants, including grasses, green up and the sites warm up here sooner than the other types.

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REVIEW LIST PLANTS
(Plants with a recent status change-
  not as rare as previously thought.)

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Carex limnophila
Castilleja parviflora var. oreopola
Douglasia laevigata var. ciliolata
Douglasia nivalis var. nivalis
Elmera racemosa var. racemosa
Epilobium watsonii var. parishii
Erigeron peregrinus var. thompsonii
Erythronium oregonum
Polystichum kruckebergii
Pyrola aphylla
Synthyris schizantha
Viola adunca var. cascedensis

* = page number in Hitchcock and Cronquist (1973), Flora of the Pacific Northwest.

TABLE IX. COMMONLY OCCURRING PLANTS OF FORESTED HABITATS, OLYMPIC NATIONAL FOREST.

TREES

TRI code	Scientific Name	Common Name
ABAM	Abies amabilis	Pacific silver fir
ABGR	Abies grandis	Grand fir
ABLA2	Abies lasiocarpa	Subalpine fir
ACMA	Acer macrophyllum	Bigleaf maple
ALRU	Alnus rubra	Red alder
ARME	Arbutus menziesii	Pacific madrone
CHNO	Chamaecyparis nootkatensis	Alaska yellowcedar
CONU	Cornus nuttallii	Pacific dogwood
PICO	Pinus contorta	Lodgepole pine
PIMO	Pinus monticola	Western white pine
PISI	Picea sitchensis	Sitka spruce
POTR2	Populus trichocarpa	Black cottonwood
PSME	Pseudotsuga menziesii	Douglas-fir
PYFU	Pyrus fusca	Western-crabapple
QUGA	Quercus garryana	Garry oak
PHPU	Phamnus purshiana	Cascara buckthorn
SALA2	Salix lasiandra	Pacific willow
SASC	Salix scouleriana	Scouler willow
TABR	Taxus brevifolia	Pacific yew
THPL	Thuja plicata	Western redcedar
TSHE	Tsuga heterophylla	Western hemlock
TSME	Tsuga mertensiana	Mountain hemlock

SHRUBS

TRI code	Scientific Name	Common Name
ACCI	Acer circinatum	Vine maple
ACGL	Acer glabrum	Rocky Mt. maple
ALSI	Alnus sinuata	Sitka alder
AMAL	Amelanchier alnifolia	Saskatoon, serviceberry
ARUV	Arctostaphylos uva-ursi	Bearberry, Kinnikinnick
BENE	Berberis nervosa	Low Oregon grape
CESA	Ceanothus sanguineus	Redstem ceanothus
COCO	Corylus cornuta	California hazelnut
COST	Cornus stolonifera	Red osier dogwood
GASH	Gaultheria shallon	Salal
HODI	Holodiscus discolor	Oceanspray
LEGR	Ledum groenlandicum	Labrador tea
LOCI	Lonicera ciliosa	Western trumpet honeysuckle
LOHI	Lonicera hispidula	California honeysuckle
MEFE	Menziesia ferruginea	Rusty menziesia, Fool's huckleberry
OECE	Oemeleria cerasiformis	Indian plum
OPHO	Oplopanax horridum	Devil's club
PAMY	Pachistima myrsinites	Myrtle pachystima, Mt. lover
PHEM	Phyllodoce empetriformis	Red mountain heather
PHLE	Philadelphus lewisii	Lewis mockorange, Syringa
RHAL	Rhododendron albiflorum	Cascades azalea, white rhododendron
RHMA	Rhododendron macrophyllum	Pacific rhododendron
RIBR	Ribes bracteosum	Stink currant
RILA	Ribes lacustre	Prickly currant
RITR	Ribes triste	American wild currant
ROGY	Rosa gymnocarpa	Baldhip rose

TRI code	Scientific Name	Common Name
RULE	Rubus leucodermis	Whitebark raspberry
RUPA	Rubus parviflorus	Western thimbleberry
RUSP	Rubus spectabilis	Salmonberry
SACA	Sambucus callicarpa	Pacific red elderberry
SARA	Sambucus racemosa	Coast red elderberry
SOSI	Sorbus sitchensis	Sitka mountain ash
SPDO	Spiraea douglasii	Douglas spiraea
SYAL	Symphoricarpos albus	Common snowberry
VAAL	Vaccinium alaskaense	Alaska huckleberry
VADE	Vaccinium deliciosum	Blue-leaf huckleberry
VAME	Vaccinium membranaceum	Thin-leaved huckleberry
VAOV	Vaccinium ovalifolium	Oval-leaf huckleberry
VAOV2	Vaccinium ovatum	Evergreen huckleberry
VAPA	Vaccinium parvifolium	Red huckleberry

HERBS

ACMI	Achillea millefolium	Western yarrow
ACTR	Achlys triphylla	Vanillaleaf
ACRU	Actaea rubra	Baneberry
ADBI	Adenocaulon bicolor	Pathfinder
ADPE	Adiantum pedatum	Maidenhair fern
AGUR	Agastache urticifolia	Nettleleaf gianthysop
AGAL	Agrostis alba	Redton
AGTE	Agrostis tenuis	Colonial bentgrass
ANLY2	Anemone lyallii	Nine-leaved anemone
ANMA	Anaphalis margaritcea	Common pearlyeverlasting
AQFO	Aquilegia formosa	Red columbine
ARAM2	Arceuthobium americanum	Dwarfmistletoe
ARMA3	Arenaria macrophylla	Bigleaf sandwort
ARLA	Arnica latifolia	Broadleaf arnica
ARSY	Aruncus sylvester	Sylvan goatsbeard
ASCA3	Asarum caudatum	Wildginger
ATFI	Athyrium filix-femina	Lady fern
BLSP	Blechnum spicant	Deer fern
BOEL	Boykinia elata	Coast boykinia
BOMA	Boykinia major	Mountain boykinia
BRPA	Bromus pacificus	Pacific brome
BRVU	Bromus vulgaris	Columbia brome
CABU2	Calypso bulbosa	Fairy slipper
CASC2	Campanula scouleri	Scouler's hairbell
CADE	Carex deweyana	Dewey's sedge
CAME2	Carex mertensii	Merten's sedge
CAPH	Carex phaeocephala	Dunhead sedge
CARO	Carex rossii	Ross' sedge
CASP	Carex spectabilis	Showy sedge
CAMI2	Castilleja miniata	Scarlet paintbrush
CAPA3	Castilleja parviflora	Magenta paintbrush
CEVU	Cerastium vulgatum	Common chickweed
CHME	Chimaphila menziesii	Little pipsissewa
CHUM	Chimaphila umbellata	Common pipsissewa
CHLE2	Chrysanthemum leucanthemum	Ox-eye daisy
CIAL	Circaea alpina	Enchanter's nightshade
CIED	Cirsium edule	Indian thistle
CIVU	Cirsium vulgare	Bull thistle

TRI code	Scientific Name	Common Name
NONE	Nothochelone nemorosa	Woodland beardtongue
OSCH	Osmorhiza chilensis	Mountain sweet-cicely
PEBR	Pedicularis bracteosa	Bracted lousewort
PERA	Pedicularis racemosa	Leafy lousewort
PEFR	Petasites frigidus	Sweet coltsfoot
PHAL	Phleum alpinum	Alpine timothy
PHDI	Phlox diffusa	Spreading phlox
POPU	Polemonium pulcherrimum	Skunkleaf polemonium
POBI	Polygonum bistortoides	American bistort
POGL4	Polypodium glycyrrhiza	Licorice fern
POMU	Polystichum munitum	Swordfern
PTAQ	Pteridium aquilinum	Bracken fern
PTAN	Pterospora andromedea	Pinedrops
PYAS	Pyrola asarifolia	Common pink pyrola
PYMI	Pyrola minor	Lesser wintergreen
PYPI	Pyrola picta	Whitevein pyrola
PYSE	Pyrola secunda	One-sided pyrola
PYUN	Pyrola uniflora	Woodnymph
RAES	Ranunculus eschscholtzii	Subalpine buttercup
RUAC	Rumex acetosella	Sheep sorrel
RULA	Rubus lasiococcus	Dwarf bramble, trailing b.
RUNI	Rubus nivalis	Snow bramble
RUPE	Rubus pedatus	Five-leaved bramble, trailing b.
RUUR	Rubus ursinus	Pacific blackberry
SEDI	Sedum divergens	Spreading sedum
SETR	Senecio triangularis	Arrowleaf groundsel
SMRA	Smilacina racemosa	Western solomon-plume, large false solomon seal
SMST	Smilacina stellata	Starry solomon-plume, small false solomon seal
STME2	Stachys mexicana	Mexicana, hedge-nettle
STAM	Streptopus amplexifolius	Clasping-leaved twisted-stalk
STRO	Streptopus roseus	Rosy twisted-stalk
TITR	Tiarella trifoliata	Three-leaved foamflower
TIUN	Tiarella unifoliata	One-leaved foamflower
TOME	Tolmiea menziesii	Youth-on-age, Pig-a-back
TRCA3	Trautvetteria caroliniensis	False bugbane
TRLA2	Trientalis latifolia	Broad-leaved starflower
TRRE	Trifolium repens	Dutch clover
TROV2	Trillium ovatum	White trillium, Wakerobin
TRCA	Trisetum canescens	Tall trisetum
TRCE	Trisetum cernuum	Nodding trisetum
TRSP	Trisetum spicatum	Spike trisetum
VASI	Valeriana sitchensis	Sitka valerian
VEVI	Veratrum viride	Green false hellebore
VIGL	Viola glabella	Pioneer violet
VIOR	Viola orbiculata	Round-leaved violet
VISE	Viola sempervirens	Evergreen violet
XETE	Xerophyllum tenax	Common beargrass

HERBS

Code	Scientific Name	Common Name
ACMI	Achillea millefolium	Western yarrow
ACTR	Achlys triphylla	Vanillaleaf
ADBI	Adenocaulon bicolor	Pathfinder
ADPE	Adiantum pedatum	Maidenhair fern
AGAU	Agoseris aurantiaca	Orange agoseris or false dandelion
AGEX	Agrostis exarata	Spike bentgrass
AGOR	Agrostis oreganensis	Oregon bentgrass
AGSC	Agrostis scabra	Winter bentgrass, rough hair grass
ALCR	Allium crenulatum	Scalloped onion
ANMA	Anaphalis margaritacea	Common pearly-everlasting
ARAM	Arnica amplexicaulis	Clasping arnica
ASCA3	Asarum caudatum	Wild ginger
ATFI	Athyrium filex-femina	Lady fern
BLSP	Blechnum spicant	Deer fern
BOMA	Boykinia major	Mountain boykinia
BRSI	Bromus sitchensis	Alaska brome
BRVU	Bromus vulgaris	Common brome
CABI	Caltha biflora	White marshmarigold
CARO3	Campanula rotundifolia	Scotch bellflower, lady's thimble
CABR6	Carex brunnescens	Brownish sedge
CACI2	Carex circinata	Coiled sedge
CADE	Carex deweyana	Dewey's sedge
CAHO	Carex hoodii	Hood's sedge
CALA	Carex laeviculmis	Smooth-stem sedge
CAME2	Carex mertensii	Merten's sedge
CANI2	Carex nigricans	Black alpine sedge
CAOB	Carex obnupta	Slough sedge
CARO	Carex rossii	Ross' sedge
CASI3	Carex sitchensis	Sitka sedge
CASP	Carex spectabilis	Showy sedge
CAST	Carex stipata	Sawbeck sedge
CAVE	Carex vesicaria	Inflated sedge
CAHI2	Castilleja hispida	Harsh paintbrush
CAMI2	Castilleja miniata	Scarlet paintbrush
CHGL	Chrysosplenium glechomaefolium	Western golden carpet
CIAL	Circaea alpina	Enchanter's nightshade
CIAR	Cirsium arvense	Canadian thistle
CIED	Cirsium edule	Edible thistle
CLLA	Claytonia lanceolata	Western spring beauty
CLUN	Clintonia uniflora	Queen's cup, bead lily
COSC	Corydalis scouleri	Scouler's corydalis
CRCR	Cryptogramma crispa	Rock-brake, parsley fern
DECA	Deschampsia caespitosa	Tufted hairgrass
DIFO	Dicentra formosa	Pacific bleedingheart
DISM	Disporum smithii	Smith fairybell
DOJE	Dodecatheon jeffreyi	Jeffrey's shooting star
DOPU2	Dodecatheon pulchellum	Few flowered shooting star
ELGL	Elymus glaucus	Blue wildrye
EPAL	Epilobium alpinum	Alpine willow-herb
EPAN	Epilobium angustifolium	Fireweed

TABLE X. COMMONLY OCCURRING PLANTS OF NON-FORESTED HABITATS, OLYMPIC NATIONAL FOREST

SHRUBS

TRI Code	Scientific Name	Common Name
ACCI	Acer circinatum	Vine maple
ACGL	Acer glabrum	Rocky mountain maple
ALSI	Alnus sinuata	Sitka alder
AMAL	Amelanchier alnifolia	Serviceberry
CAME	Cassiope mertensiana	White Mt. heather
JUCO4	Juniperus communis	Common juniper
OPHO	Oplopanax horridum	Devil's club
PAMY	Pachystima myrsenites	Myrtle pachystima, Mt. lover
PHEM	Phyllodoce empetriformis	Red mountain heather
RIBR	Ribes bracteosum	Stinking black currant
ROGY	Rosa gymnocarpa	Baldhip rose
RUPA	Rubus parviflorus	Western thimbleberry
RUSP	Rubus spectabilis	Salmonberry
SARA	Sambucus racemosa	Coast red elderberry
SPDO	Spiraea douglasii	Douglas spiraea
SOSI	Sorbus sitchensis	Sitka mountain ash
VAAL	Vaccinium alaskaense	Alaska huckleberry
VAME	Vaccinium membranaceum	Thin-leaved huckleberry
VAPA	Vaccinium parvifolium	Red huckleberry
VAOV	Vaccinium ovalifolium	Oval-leaf huckleberry
VASC	Vaccinium scoparium	Grouse whortleberry

TRI Code	Scientific Name	Common Name
EPGL	Epilobium glaberrimum	Common willow-herb
EQAR	Equisetum arvense	Common horsetail
ERPE	Erigeron peregrinus	Subalpine daisy
ERLA	Eriophyllum lanatum	Common eriophyllum
ERAR2	Erysimum arenicola	Sand-dwelling wallflower
ERMO	Erythronium montanum	Alpine fawn-lily
FEOV	Festuca ovina	Sheep fescue
FESU	Festuca subulata	Bearded fescue
FRVI	Fragaria virginiana	Broadpetal strawberry
GAAP	Galium aparine	Catchweed bedstraw
GABO	Galium boreale	Northern bedstraw
GAOR	Galium oreganum	Oregon bedstraw
GATR	Galium triflorum	Fragrant bedstraw
GATR3	Galium trifidum	Small bedstraw
GLEL	Glyceria elata	Tall mannagrass
GYDR	Gymnocarpium dryopteris	Oak fern
HASA	Habenaria saccata	Slendar bog-orchid
HEOC	Hedysarum occidentale	Western hedysarum or sweetvetch
HELA	Heracleum lanatum	Cow parsnip
HIAL	Hieracium albiflorum	White flowered hawkweed
HYTE	Hydrophyllum tenuipes	Slender-stemmed waterleaf
HYRA	Hypochaeris radicata	Spotted or Hairy cat's ear
JUME	Juncus mertensianus	Merten's rush
LAMU	Lactuca muralis	Wall lettuce
LEPY2	Leptarrhena pyrolifolia	False saxifrage
LECO	Lewisia columbiana	Columbia lewisia
LIBO2	Linnaea borealis	Twinflower
LICO4	Lilium columbianum	Columbia lily
LOMA2	Lomatium martindalei	Martindale's lomatium
LUPE	Luetkea pectinata	Partridge foot
LULA	Lupinus latifolius	Broadleaf lupine
LUHI	Luzula hitchcockii	Smooth woodrush
LUPA	Luzula parviflora	Millet woodrush
LYAM	Lysichitum americanum	Skunk cabbage
MADI	Maianthenum dilatatum	Beadruby
MIBR	Mitella breweri	Brewer's mitrewort
MIOV	Mitella ovalis	Oval-leaved mitrewort
MOSI	Montia siberica	Candyflower
MYLA	Myosotis laxa	Small-flowered forget-me-not
NONE	Nothochelone nemorosa	Woodland beardtongue
OESA	Oenanthe sarmentosa	Pacific waterdropwort
OSCH	Osmorhiza chilensis	Mountain sweet-cicely
PERA	Pedicularis racemosa	Leafy lousewort
PEDA	Penstemon davidsonii	Davidson's penstemon
PEFRP	Petasites frigidus palmatus	Sweet colt's foot
PEHE	Petrophytum hendersonii	Henderson rockmat
PHPR	Phleum pratense	Timothy
PHDI	Phlox diffusa	Spreading phlox
POBI	Polygonum bistortoides	American bistort
PODO	Polygonum douglasii	Douglas' knotweed
POAN3	Polystichum andersonii	Anderson's swordfern

TRI Code	Scientific Name	Common Name
POLO2	Polystichum lonchitis	Mountain holly-fern
POMU	Polystichum munitum	Swordfern
PTAQ	Pteridium aquiliuum	Brakenfern
RAFL2	Ranunculus flammula	Creeping buttercup
RONA	Rorippa nasturtium-aquaticum	Watercress
RUUR	Rubus ursinus	Pacific blackberry
RUOB	Rumex obtusifolius	Bitter dock, Broad leaved dock
SAPU	Saxifraga punctata	Dotted saxifrage
SCMI	Scirpus microcarpus	Small fruited bullrush, panicled bullrush
SEDI	Sedum divergens	Spreading stonecrop
SESY	Senecio sylvaticus	Wood groundsel
SIDO2	Silene douglasii	Douglas' silene
SMRA	Smilacina racemosa	Western solomon-plume, large false solomon seal
SMST	Smilacina stellata	Starry solomon-plume, small false solomon seal
STME2	Stachys mexicana	Mexicana betony or hedge nettle
TEGR	Tellima grandiflora	Fringecup
THOC	Thalictrum occidentale	Western meadowrue
TITR	Tiarella trifoliata	Three-leaved foamflower
TIUN	Tiarella unifoliata	One-leaved foamflower
TOME	Tolmiea menziesii	Youth-on-age, Pig-a-back
TRCA3	Trautvetteria caroliniensis	False bugbane
TRLA2	Trientalis latifolia	Broad-leaved starflower
TROV	Trillium ovatum	White trillium, Wakerobin
URDI	Urtica dioica	Nettle
VASI	Valeriana sitchensis	Sitka valerian
VEVI	Veratrum viride	Green false hellebore
VEAN	Veronica anagallis-aquatica	Water speedwell
VIGL	Viola glabella	Pioneer violet
VIPA2	Viola palustris	Marsh violet

Trees

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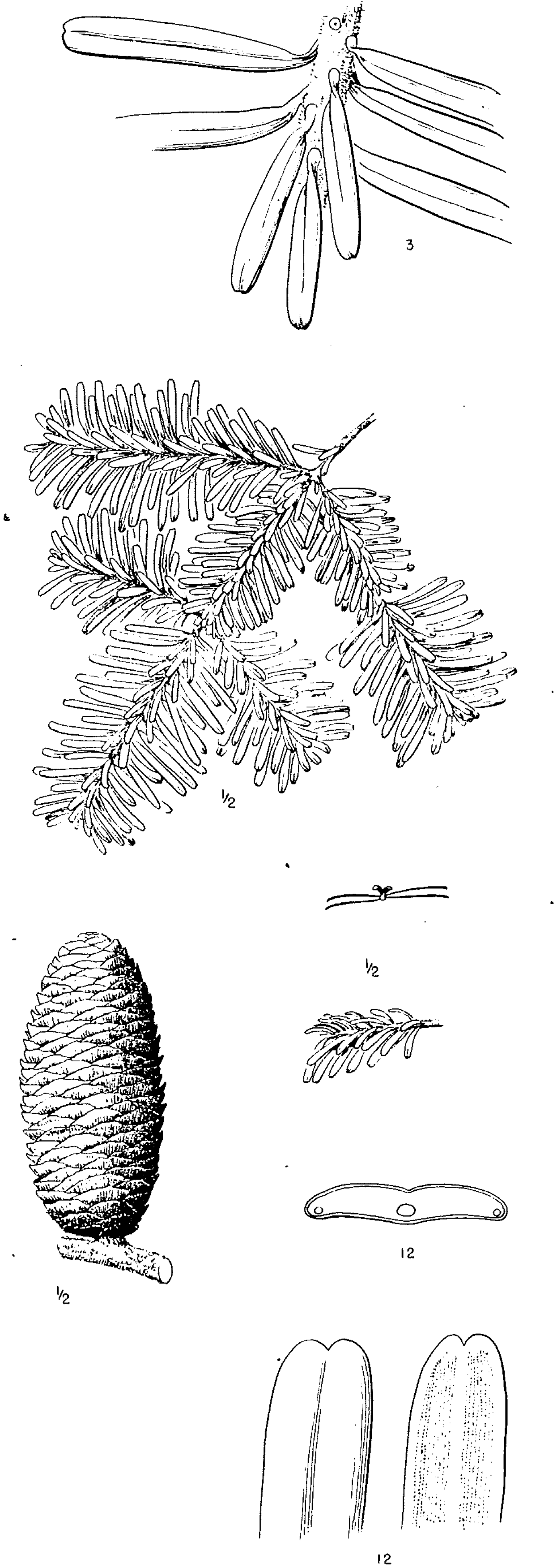
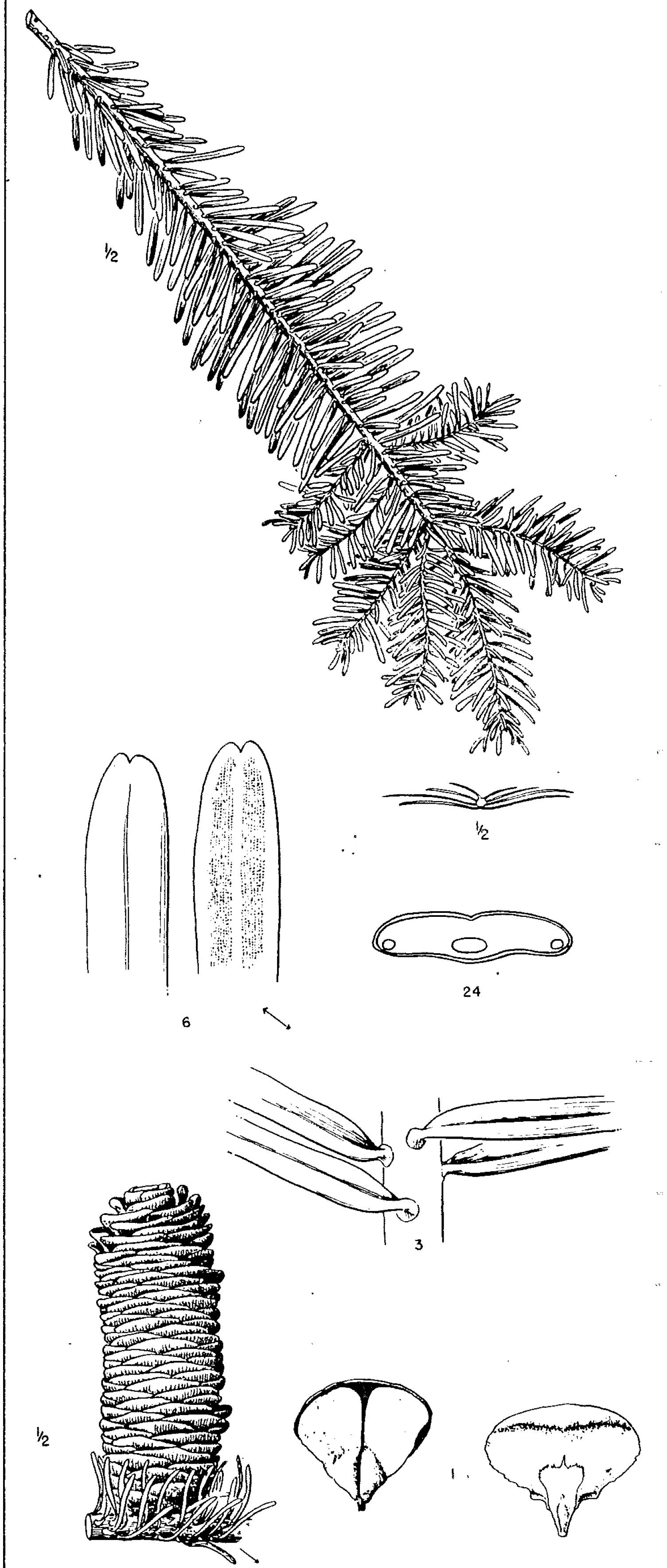


PACIFIC SILVER FIR

<u>Abies</u> <u>amabilis</u>

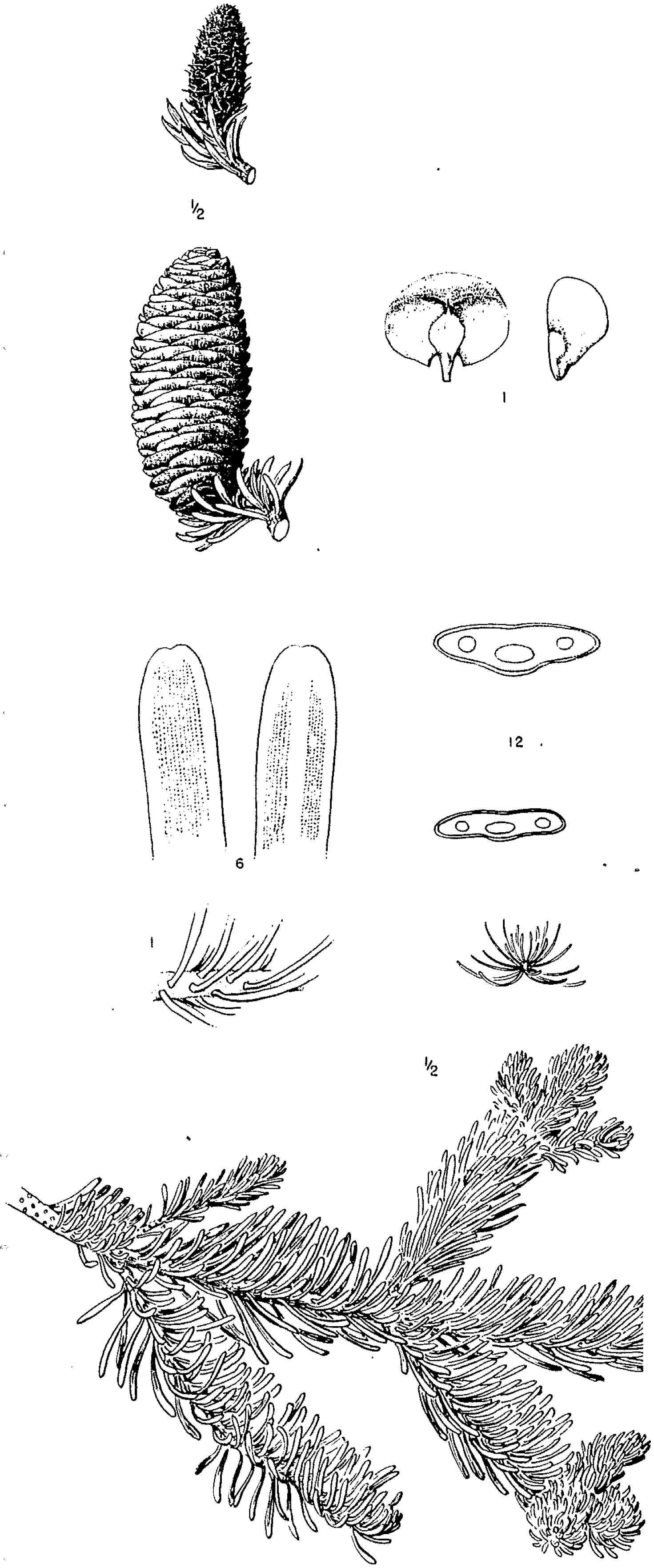
(Abam)



GRAND FIR

<u>Abies</u> <u>grandis</u>

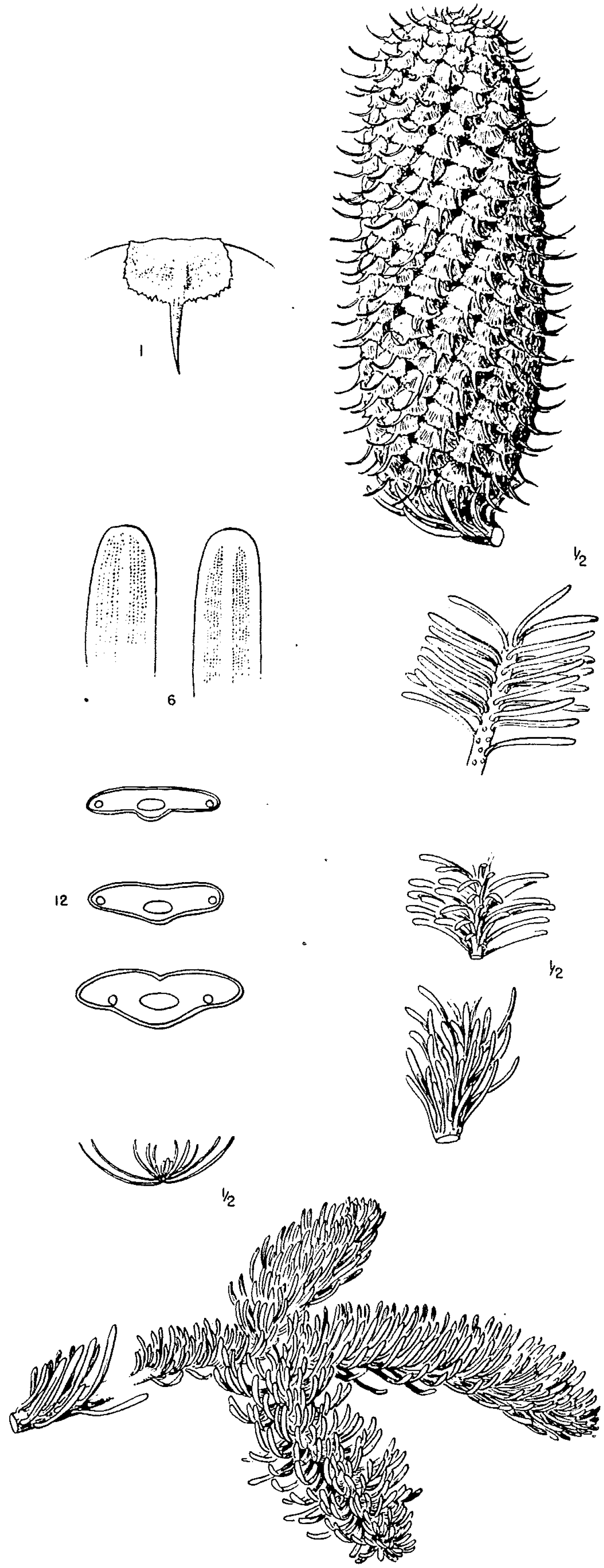
(Abgr)



SUBALPINE FIR

Abies lasiocarpa

(Abla2)



NOBLE FIR

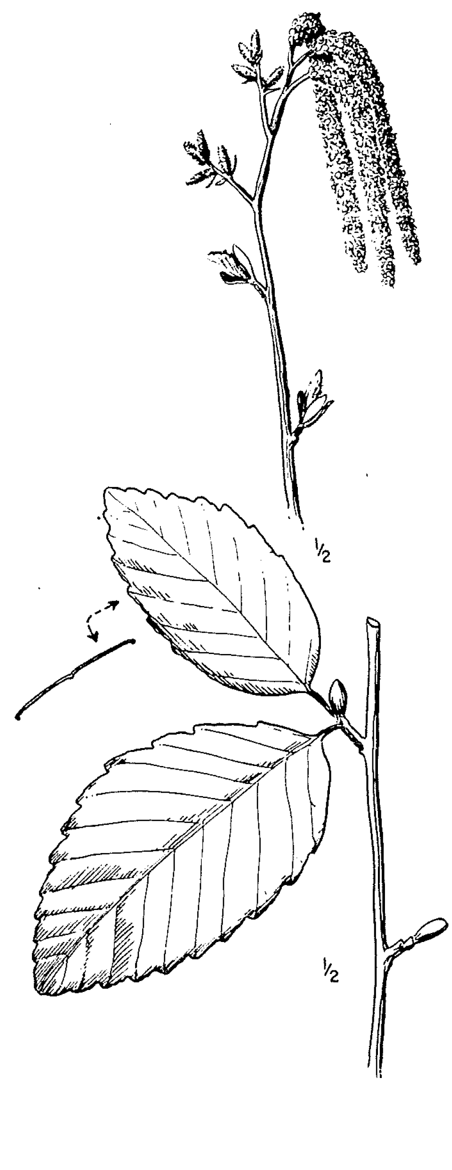
Abies procera

(Abpr)

BIGLEAF MAPLE

Acer macrophyllum

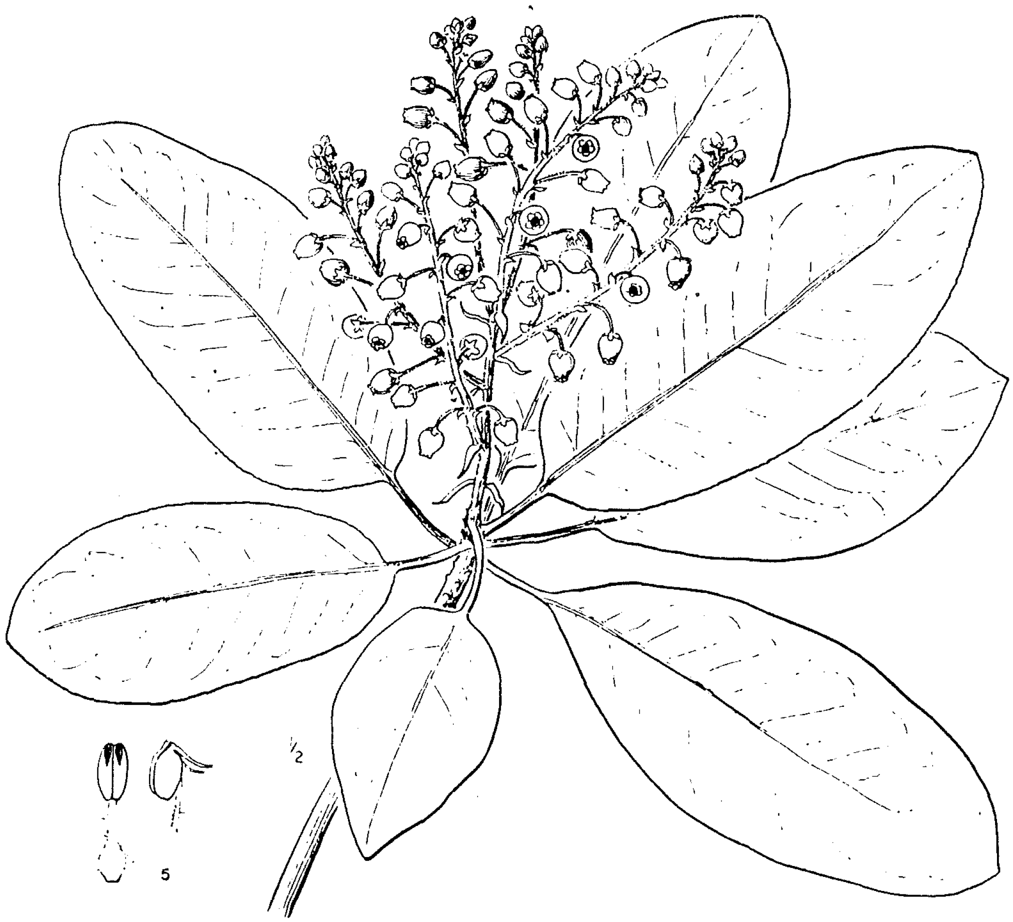
(Acma)



RED ALDER

Alnus rubra

(Alru)



PACIFIC MADRONE

Arbutus menziesii

(Arme)

ALASKA YELLOWCEDAR

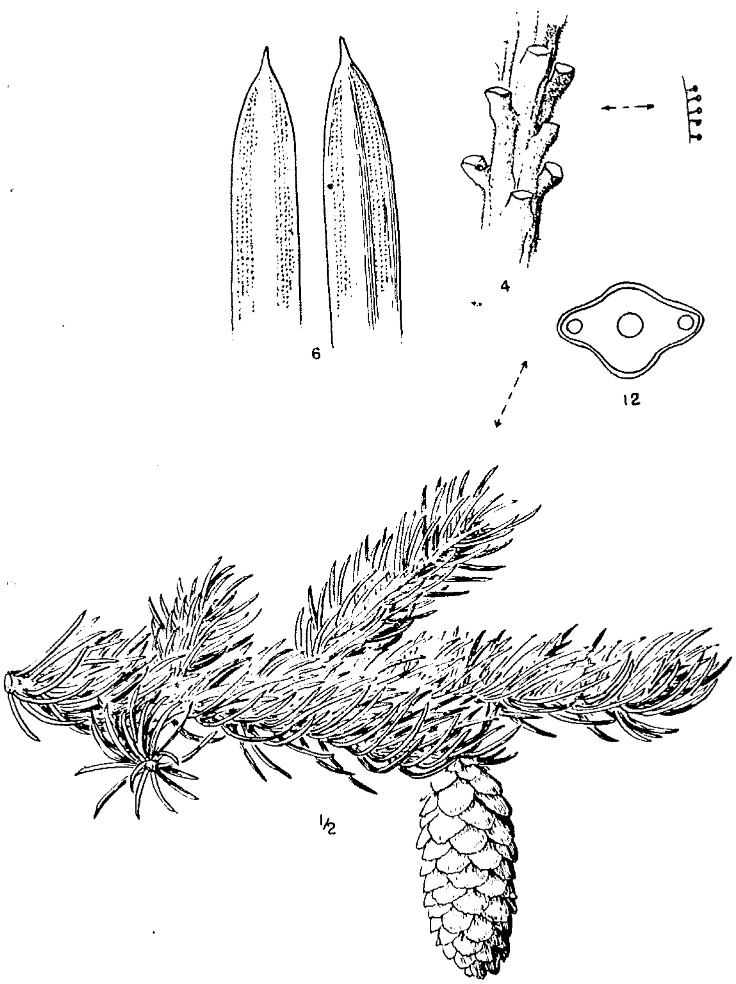
Chamaecyparis nootkatensis

(Chno)

PACIFIC DOGWOOD

Cornus nuttallii

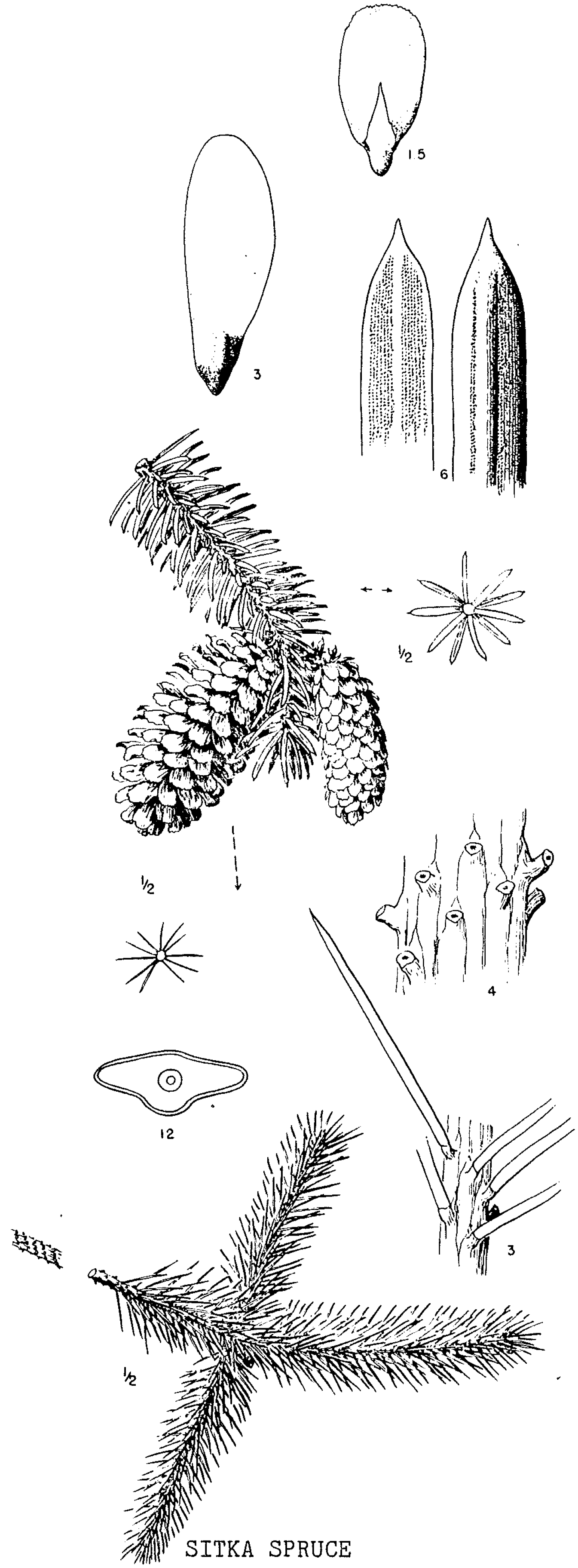
(Conu)



ENGLEMANN SPRUCE

Picea engelmannii

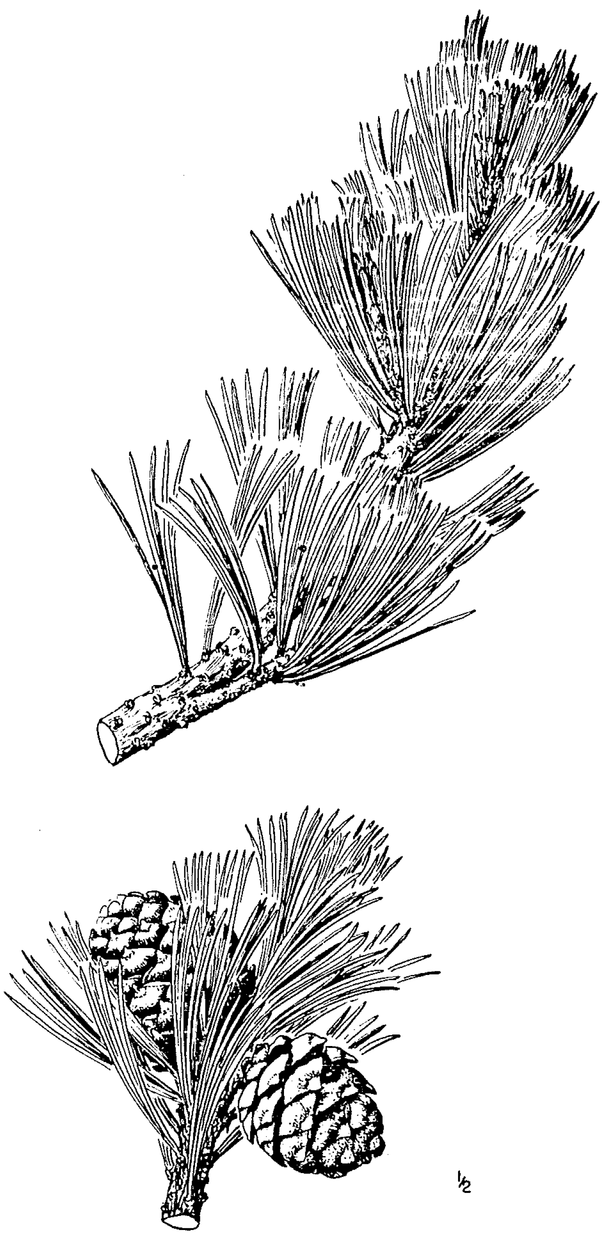
(Pien)



SITKA SPRUCE

Picea sitchensis

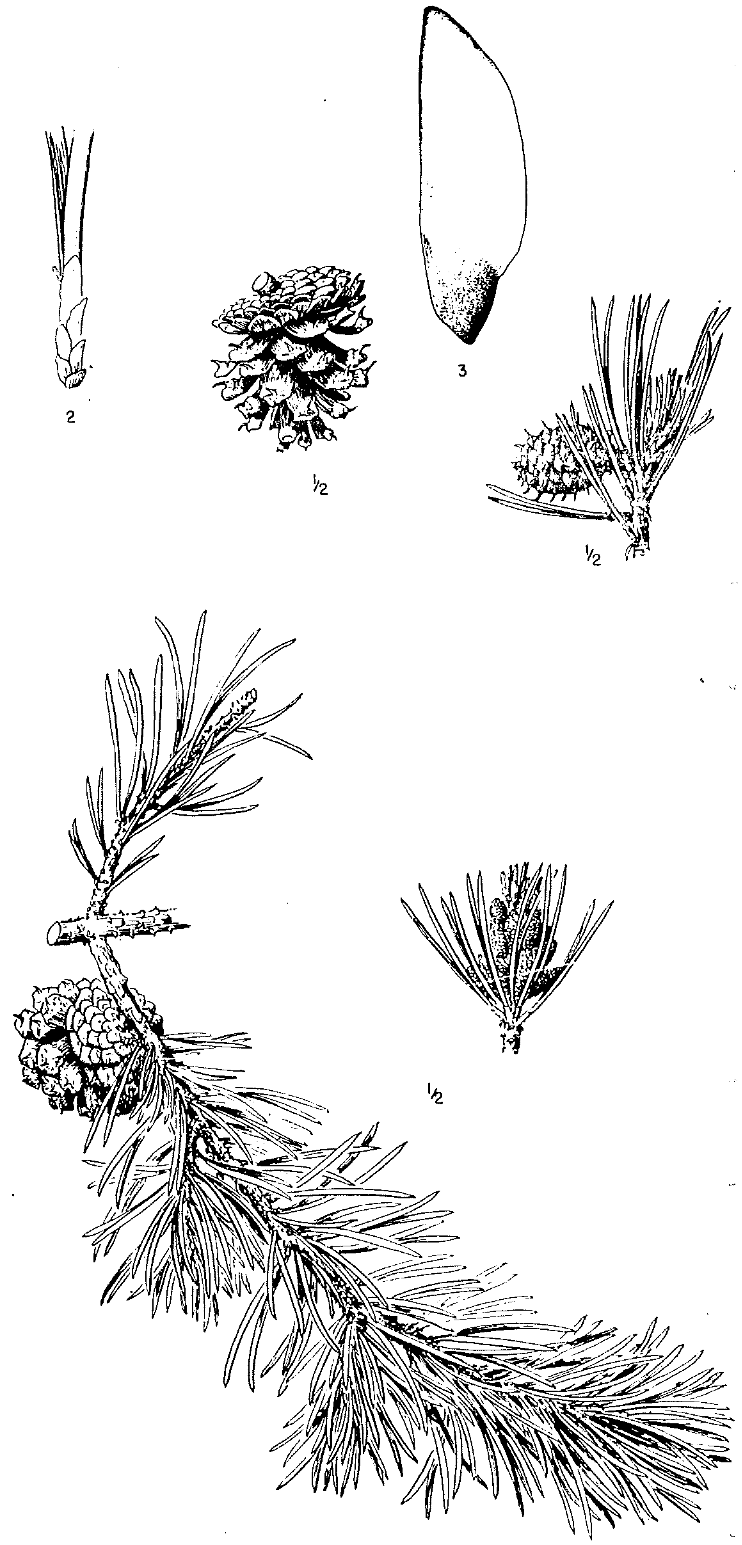
(Pisi)



WHITEBARK PINE

Pinus albicaulis

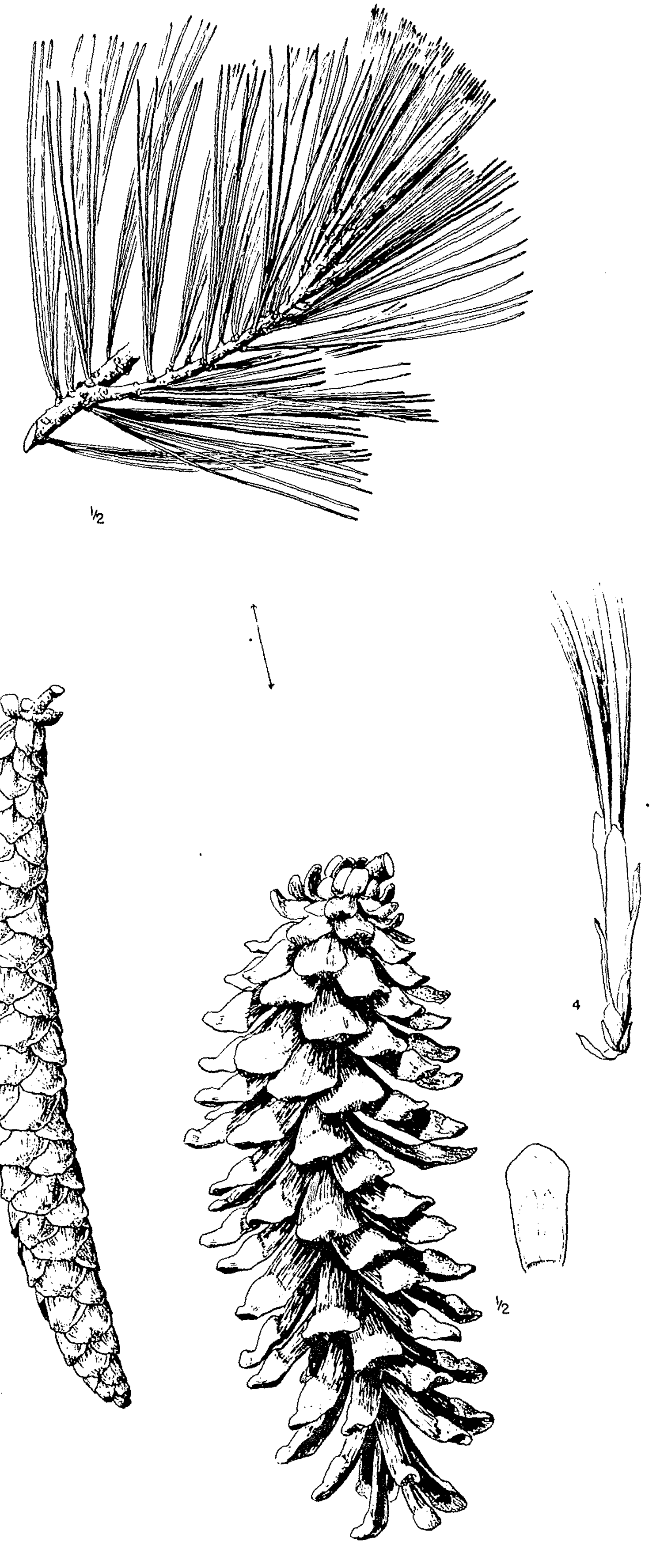
(Pial)



LODGEPOLE PINE

Pinus contorta

(Pico)



WESTERN WHITE PINE

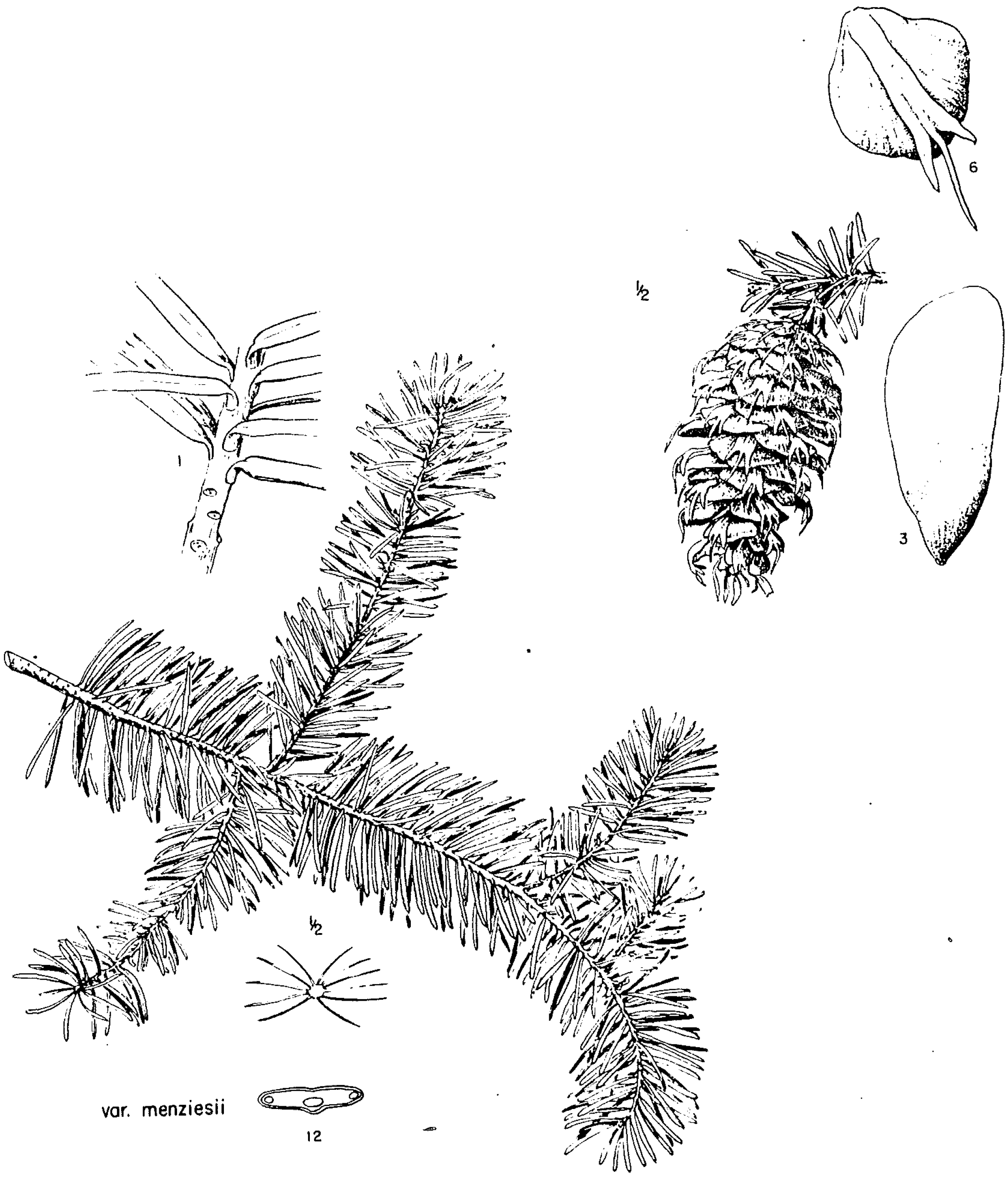
Pinus monticola

(Pimo)

BLACK COTTONWOOD

Populus trichocarpa

(Potr2)



DOUGLAS-FIR

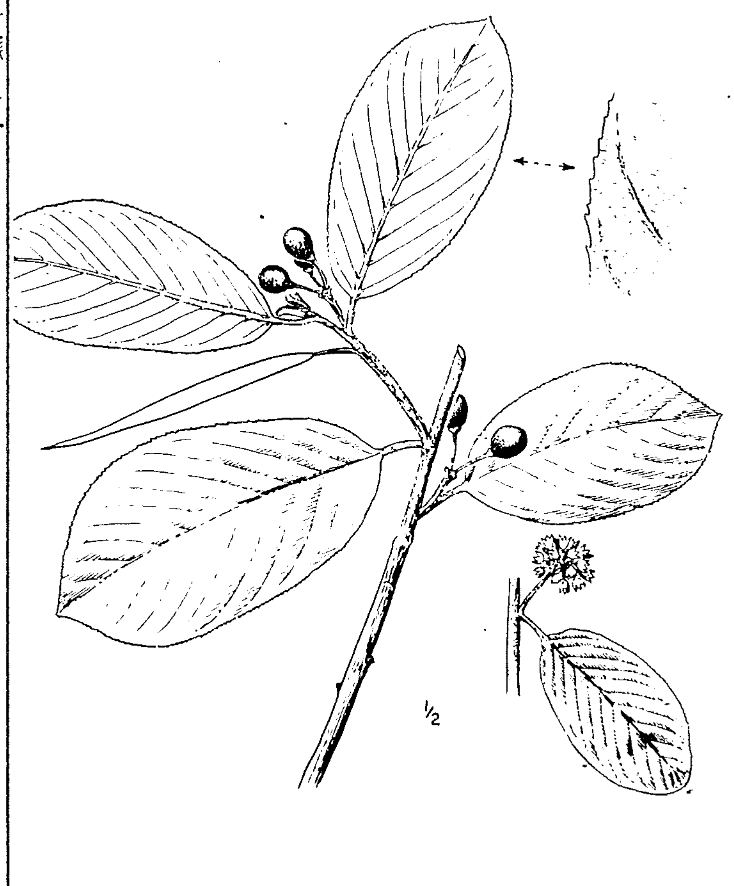
<u>Pseudotsuga</u> <u>menziesii</u> <u>menziesii</u>

(Psmem)

GARRY OAK

Quercus garryana

(Quga)



CASCARA BUCKTHORN

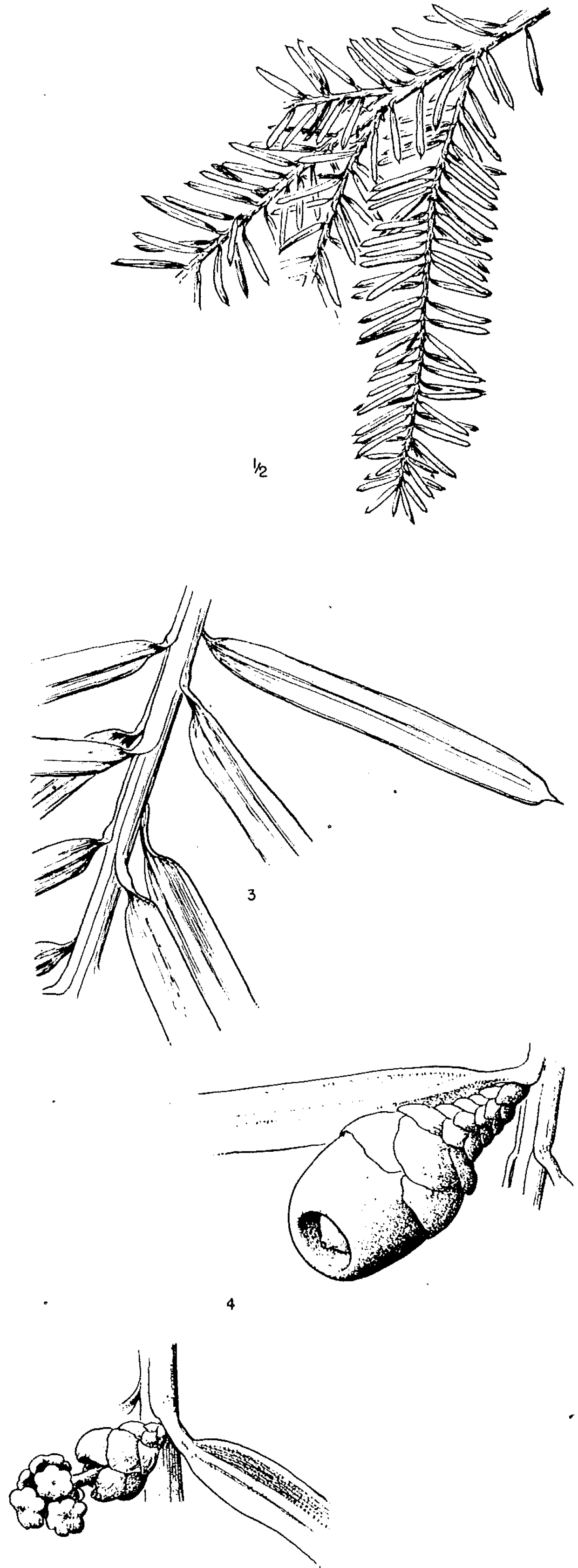
Rhamnus purshiana

(Rhpu)

SCOULER WILLOW

<u>Salix</u> <u>scouleriana</u>

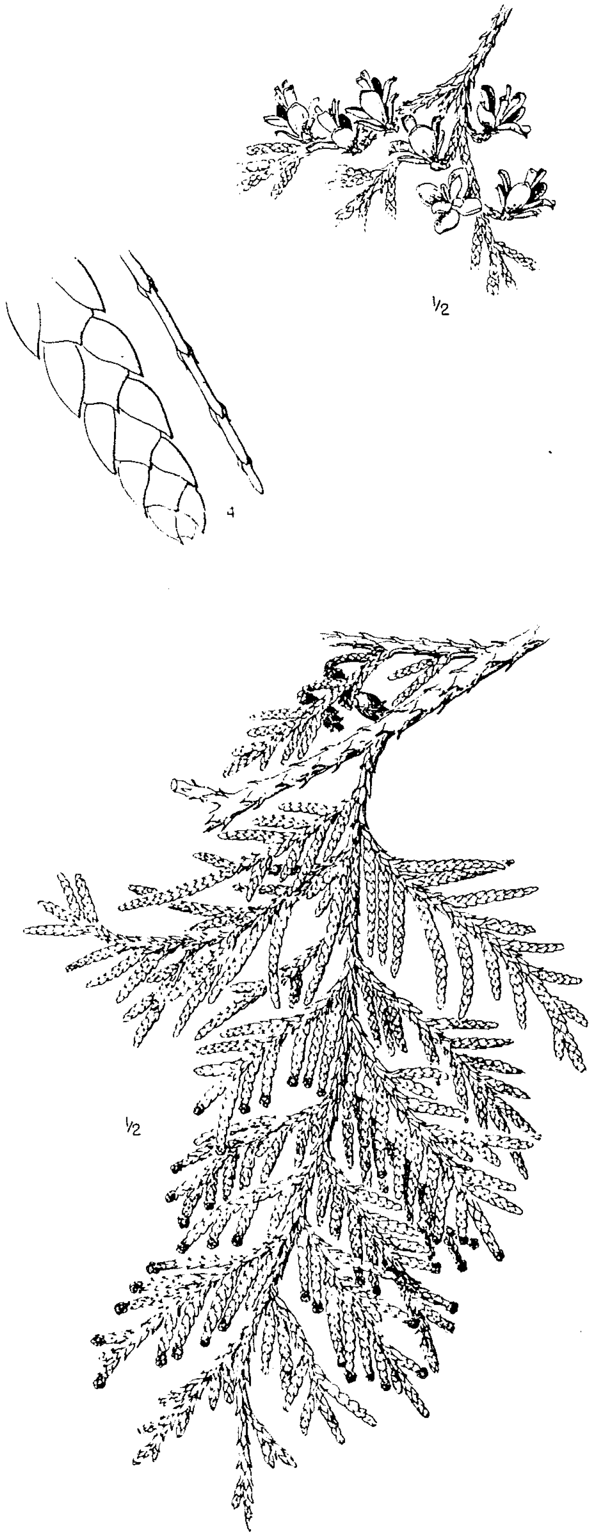
(Sasc)



PACIFIC YEW

<u>Taxus</u> <u>brevifolia</u>

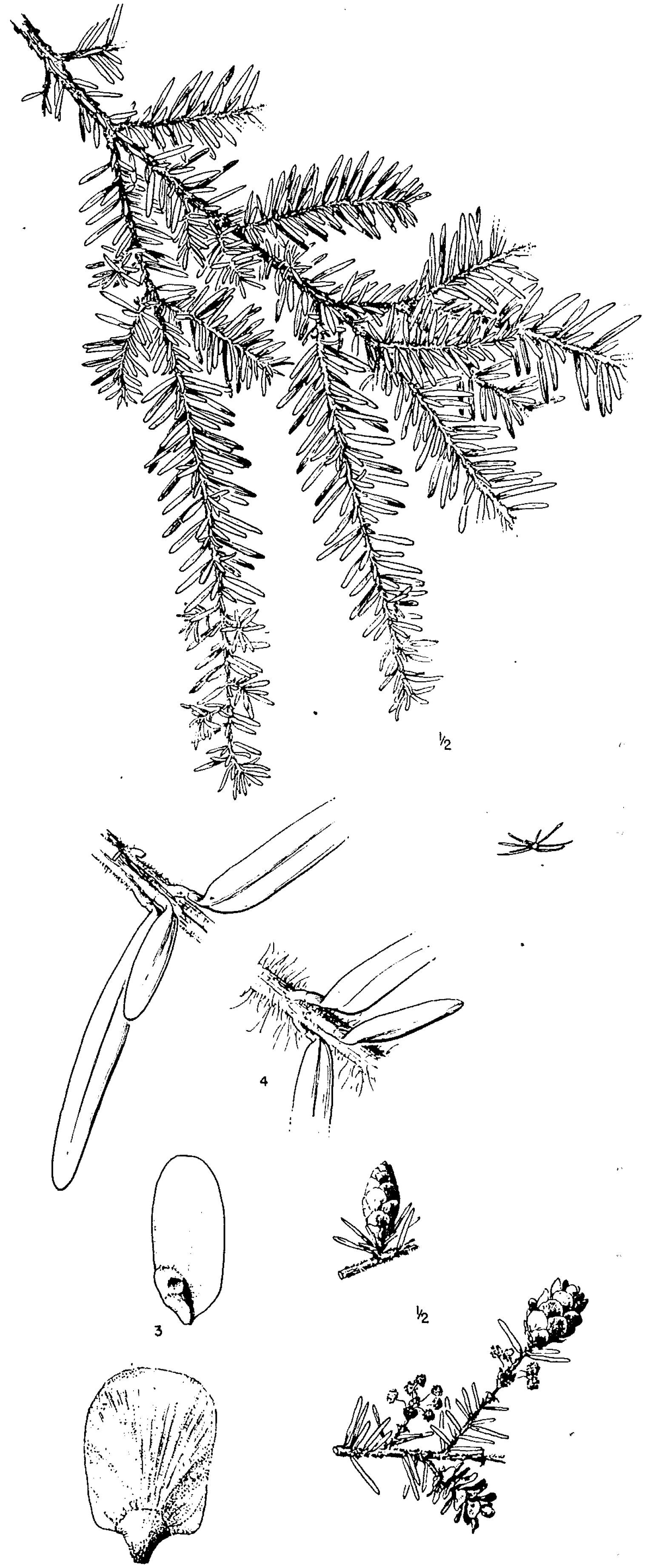
(Tabr)



WESTERN REDCEDAR

Thuja plicata

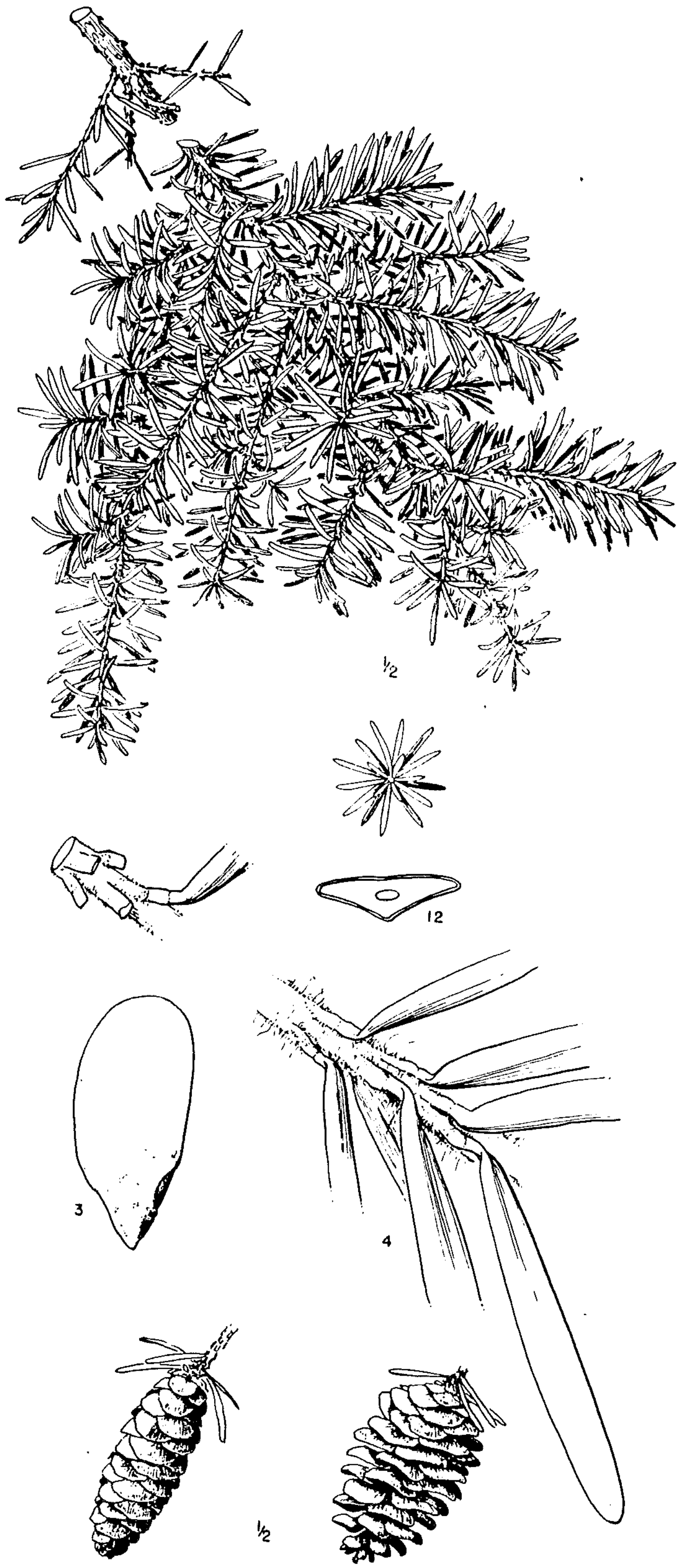
(Thpl)



WESTERN HEMLOCK

Tsuga heterophylla

(Tshe)



MOUNTAIN HEMLOCK

<u>Tsuga</u> <u>mertensiana</u>

(Tsme)

Shrubs

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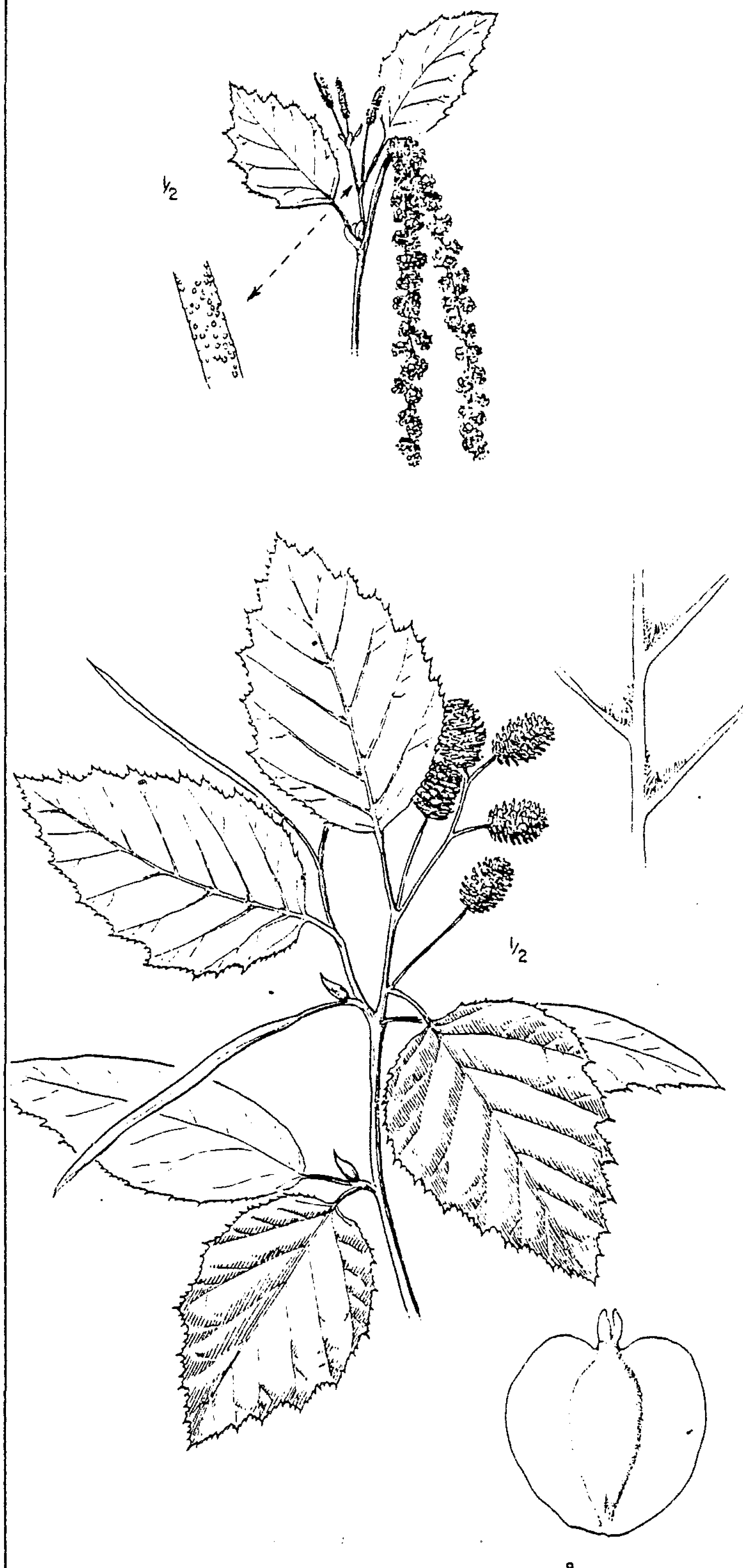
VINE MAPLE

<u>Acer</u> <u>circinatum</u>

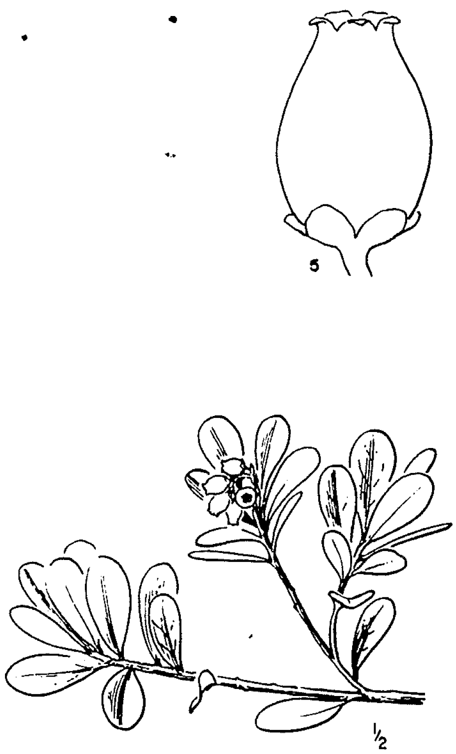
(Acci)



SITKA ALDER

<u>Alnus</u> <u>sinuata</u>

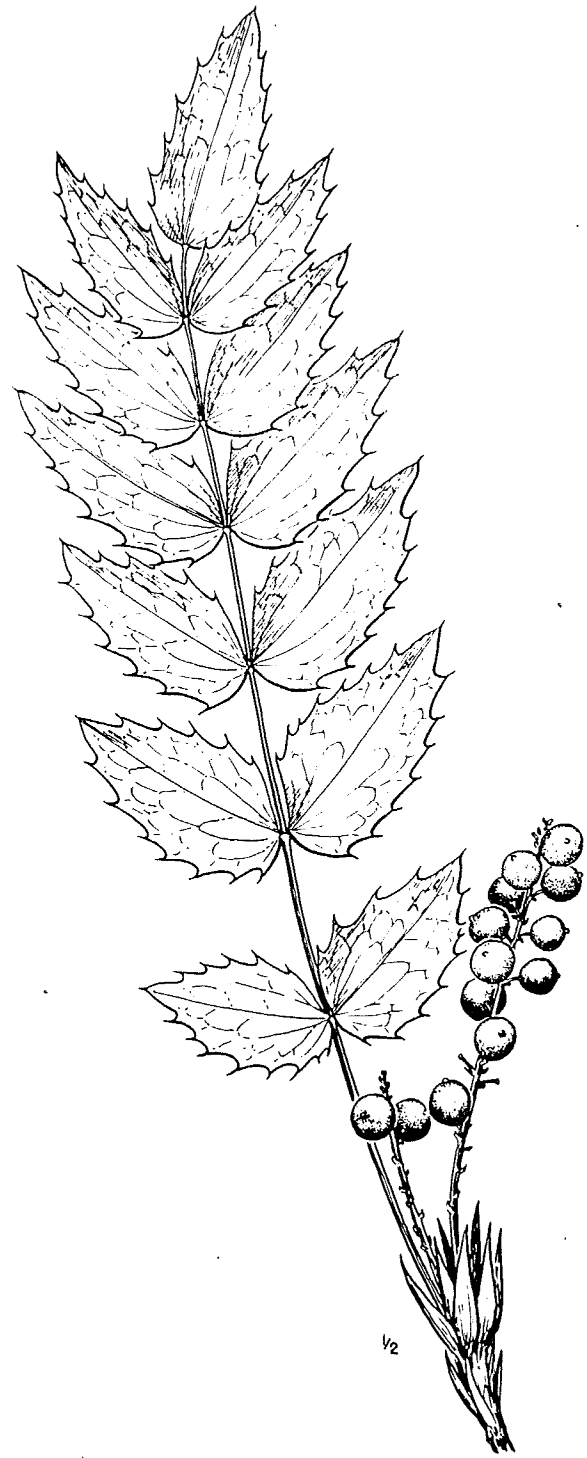
(Alsi)



BEARBERRY, KINNIKINNICK

Arctostaphylos uva-ursi

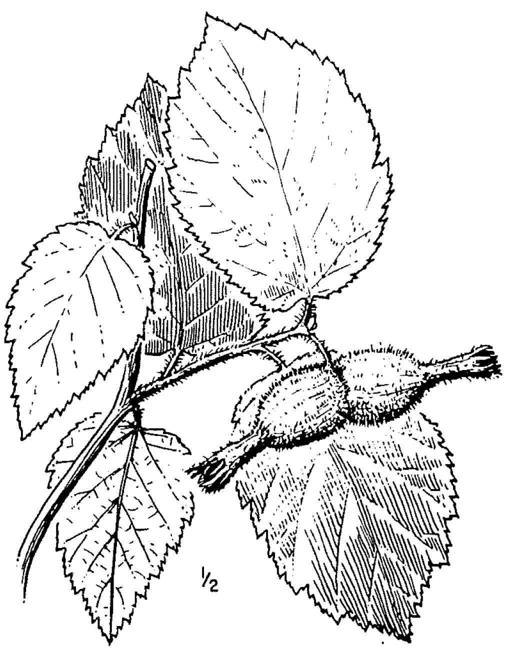
(Aruv)



LOW OREGONGRAPE

Berberis nervosa

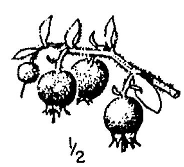
(Bene)



CALIFORNIA HAZELNUT

Corylus cornuta californica

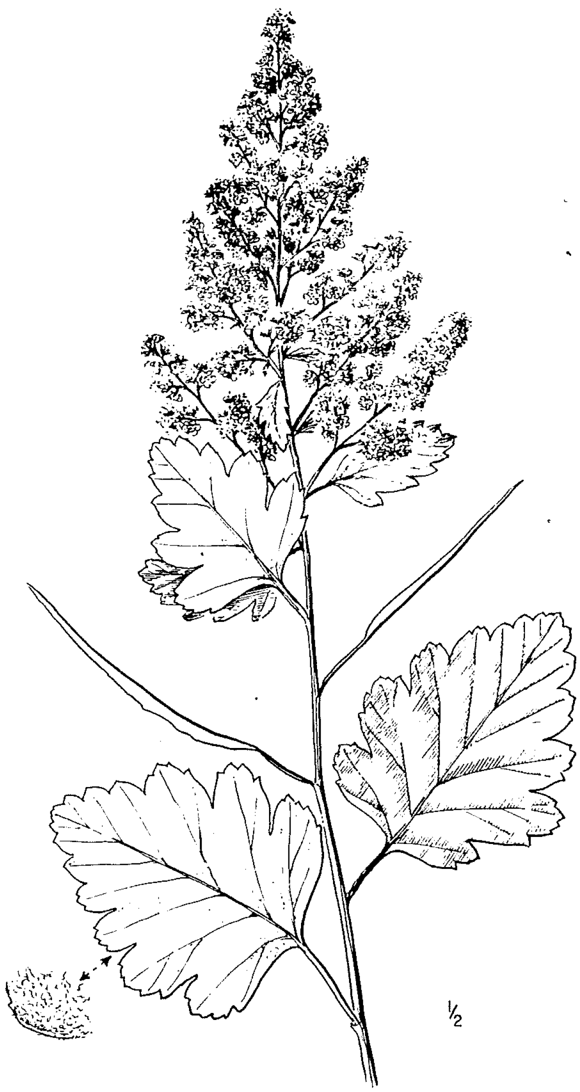
(Cococ)



SALAL

Gaultheria shallon

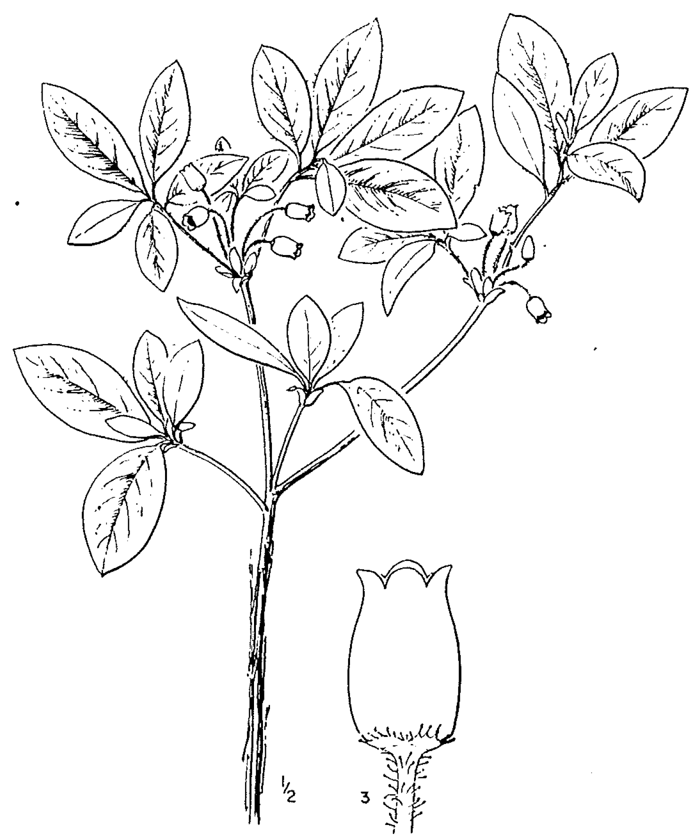
(Gash)



OCEANSPRAY

Holodiscus discolor

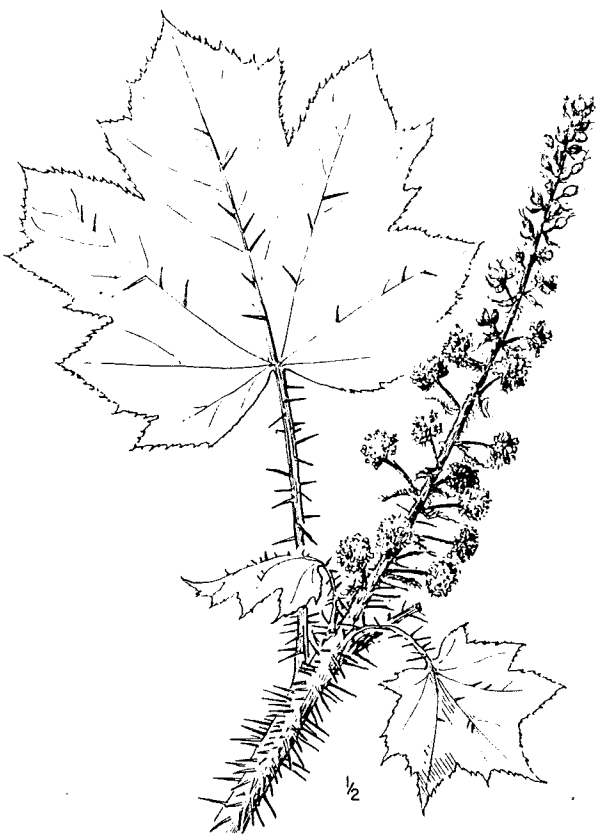
(Hodi)



RUSTY MENZIESIA, FOOL'S HUCKLEBERRY

Menziesia ferruginea

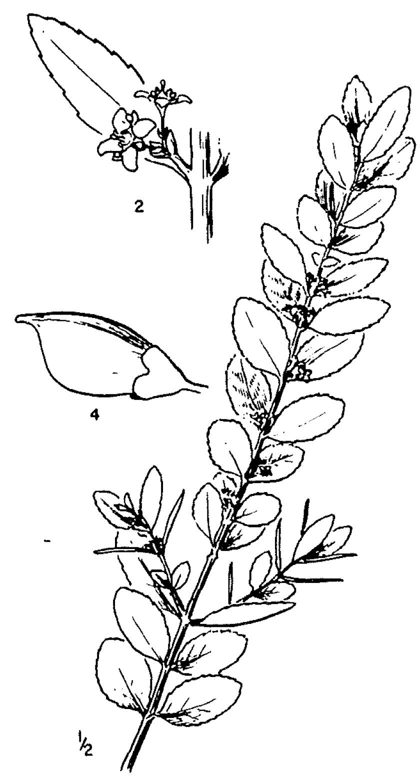
(Mefe)



DEVIL'S CLUB

<u>Oplopanax</u> <u>horridum</u>

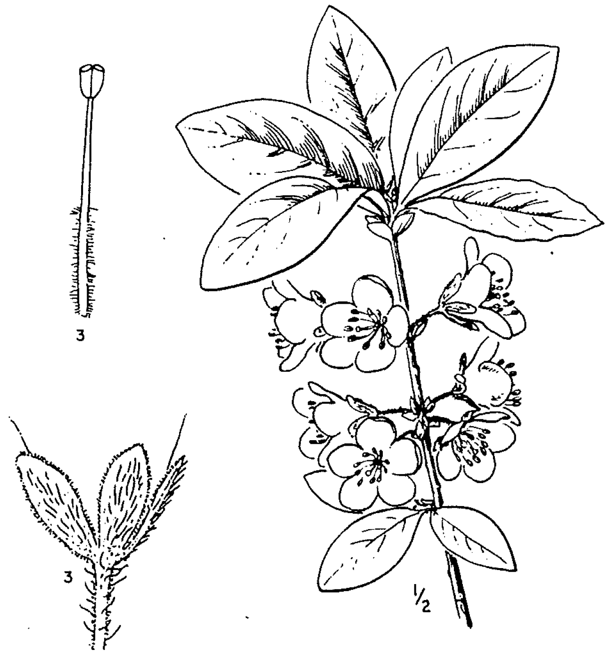
(Opho)



MYRTLE PACHYSTIMA, MT. LOVER

<u>Pachistima</u> <u>myrsinites</u>

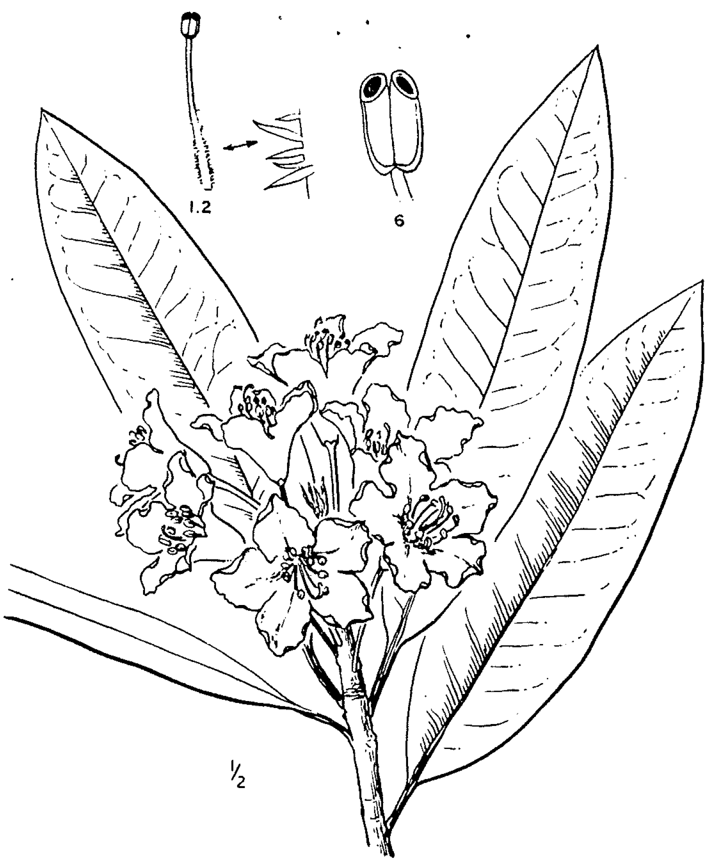
(Pamy)



CASCADES AZALEA, WHITE RHODODENDRON

Rhododendron albiflorum

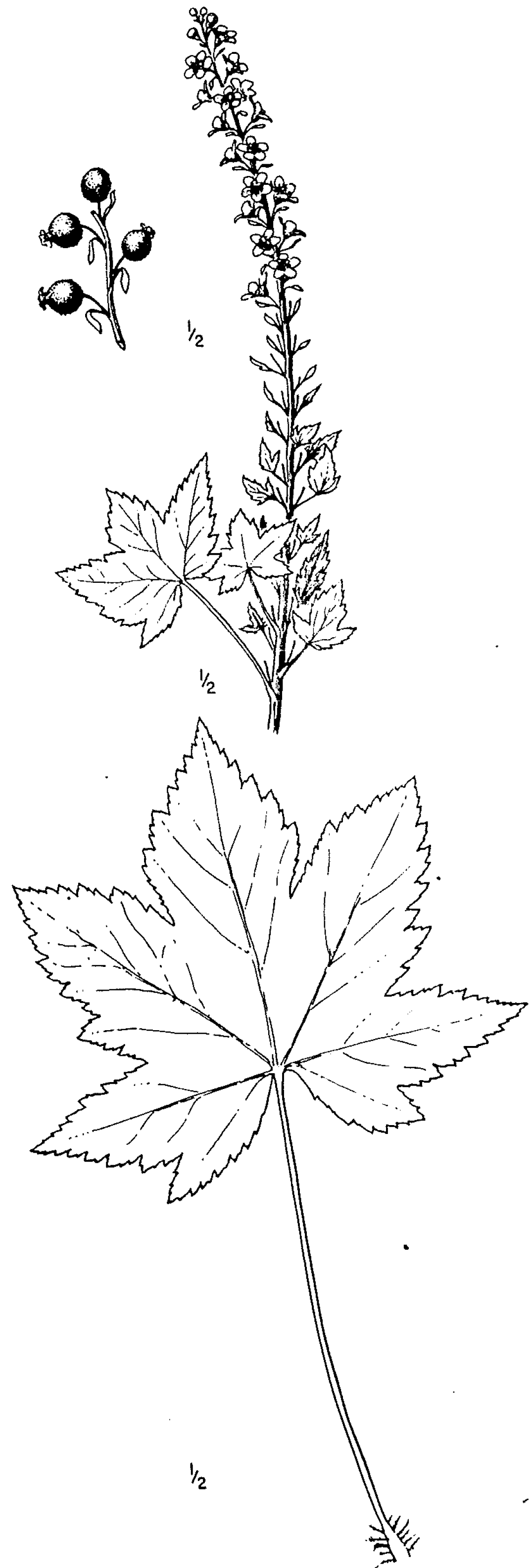
(Rhal)



PACIFIC RHODODENDRON

Rhododendron macrophyllum

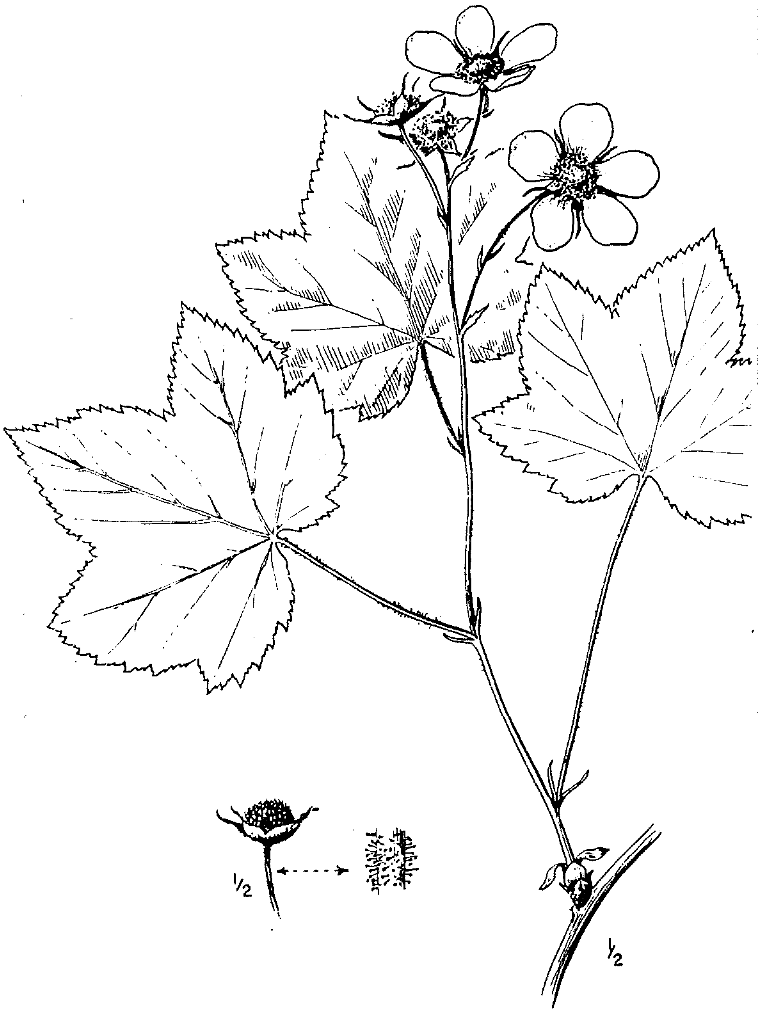
(Rhma)



STINK CURRANT

Ribes bracteosum

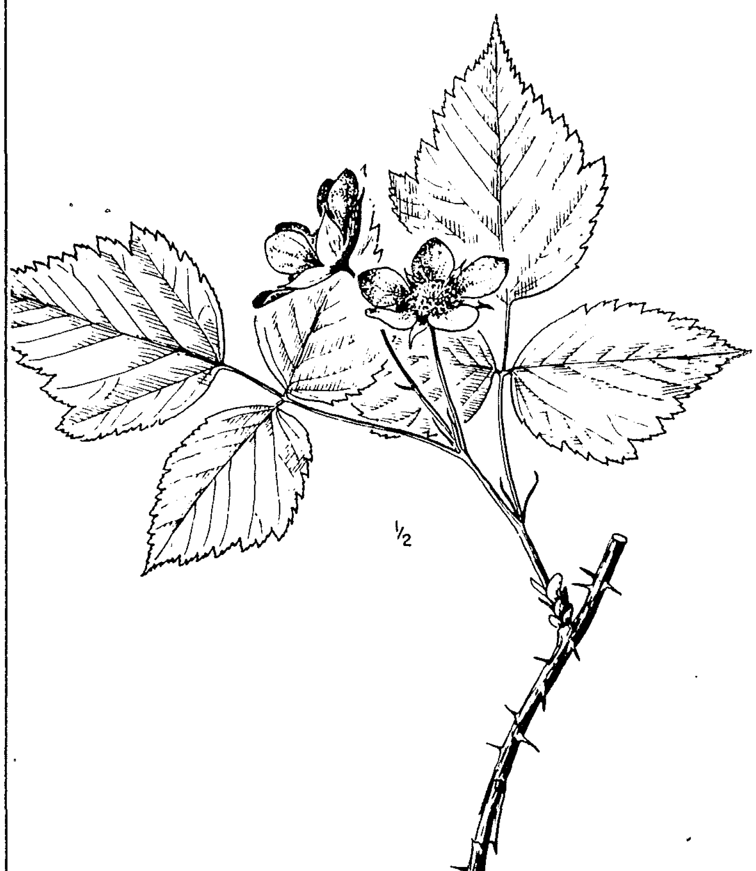
(Ribr)



WESTERN THIMBLEBERRY

Rubus parviflorus

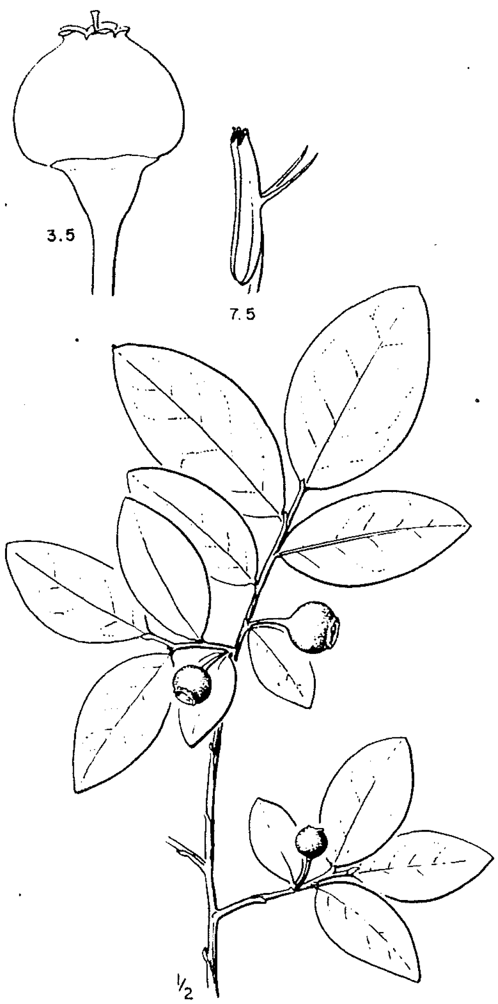
(Rupa)



SALMONBERRY

Rubus spectabilis

(Rusp)



ALASKA HUCKLEBERRY

<u>Vaccinium alaskaense</u>

(Vaal)

BLUE-LEAF HUCKLEBERRY

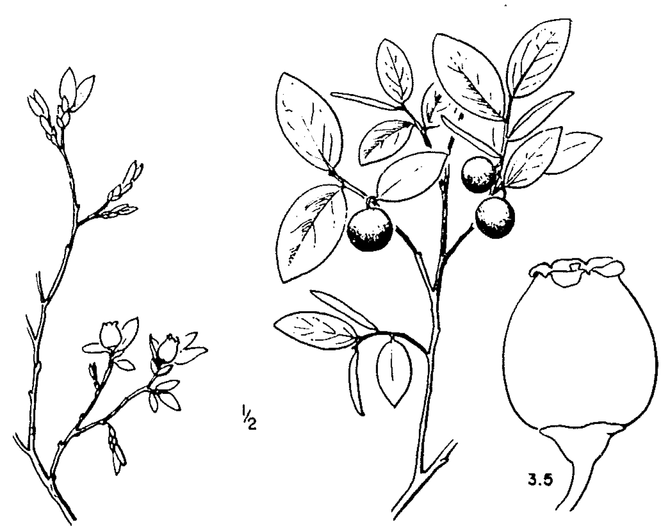
<u>Vaccinium deliciosum</u>

(Vade)

THIN-LEAVED HUCKLEBERRY

Vaccinium membranaceum

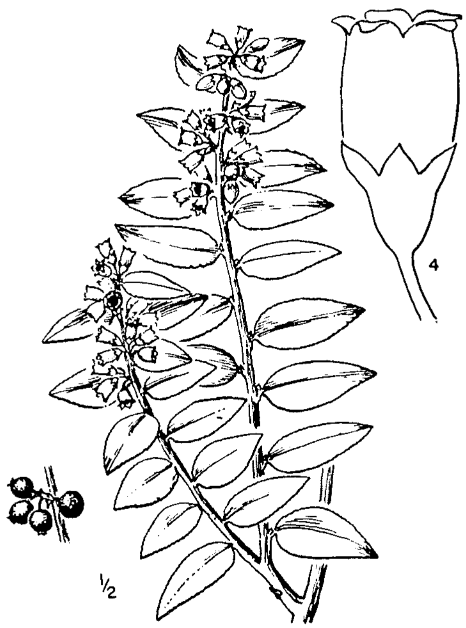
(Vame)



OVAL-LEAF HUCKLEBERRY

Vaccinium ovalifolium

(Vaov)



EVERGREEN HUCKLEBERRY

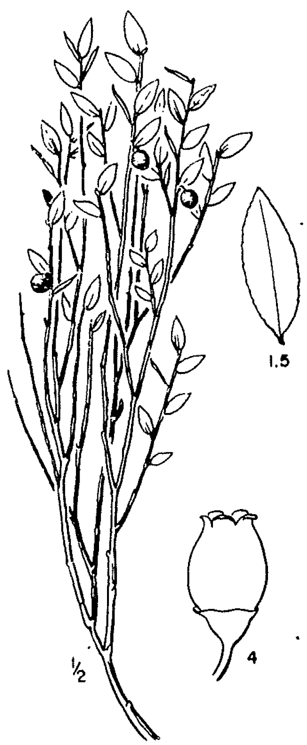
Vaccinium ovatum

(Vaov2)

RED HUCKLEBERRY

Vaccinium parvifolium

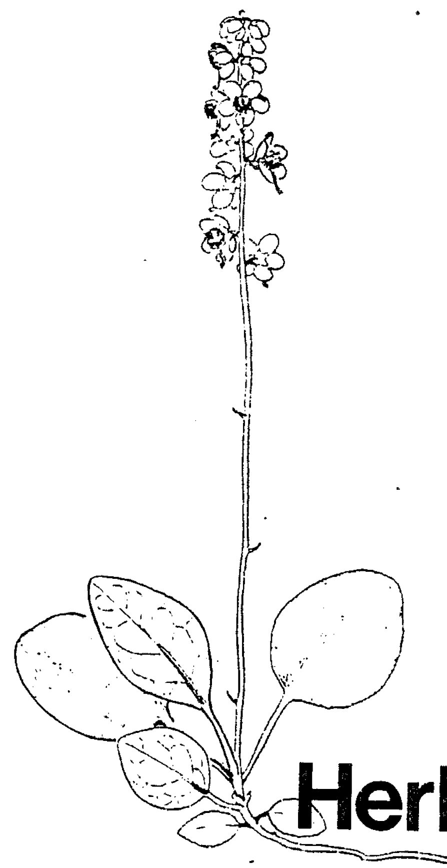
(Vapa)



GROUSE WHORTLEBERRY

Vaccinium scoparium

(Vasc)



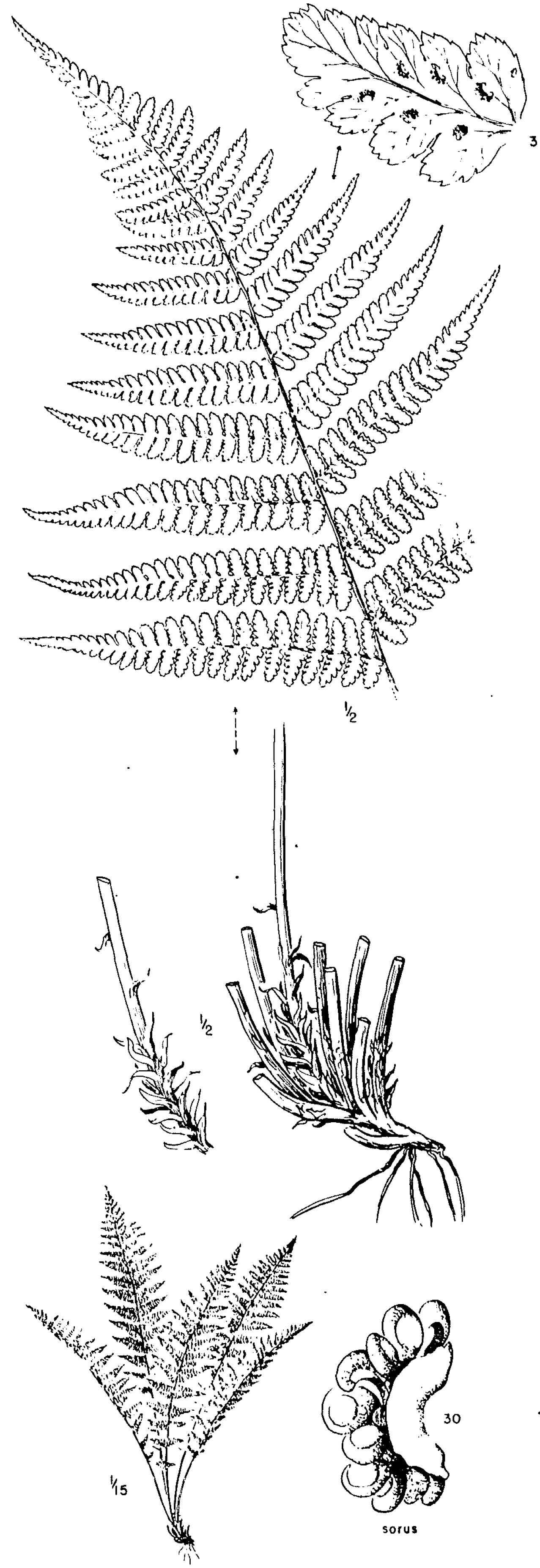
Herbs

The following illustrations by Jeanne R. Janish and reproduced by permission from Hitchcock et al. 1955-1969. Vascular Plants of the Pacific Northwest.

VANILLALEAF

<u>Achlys</u> <u>triphylla</u>

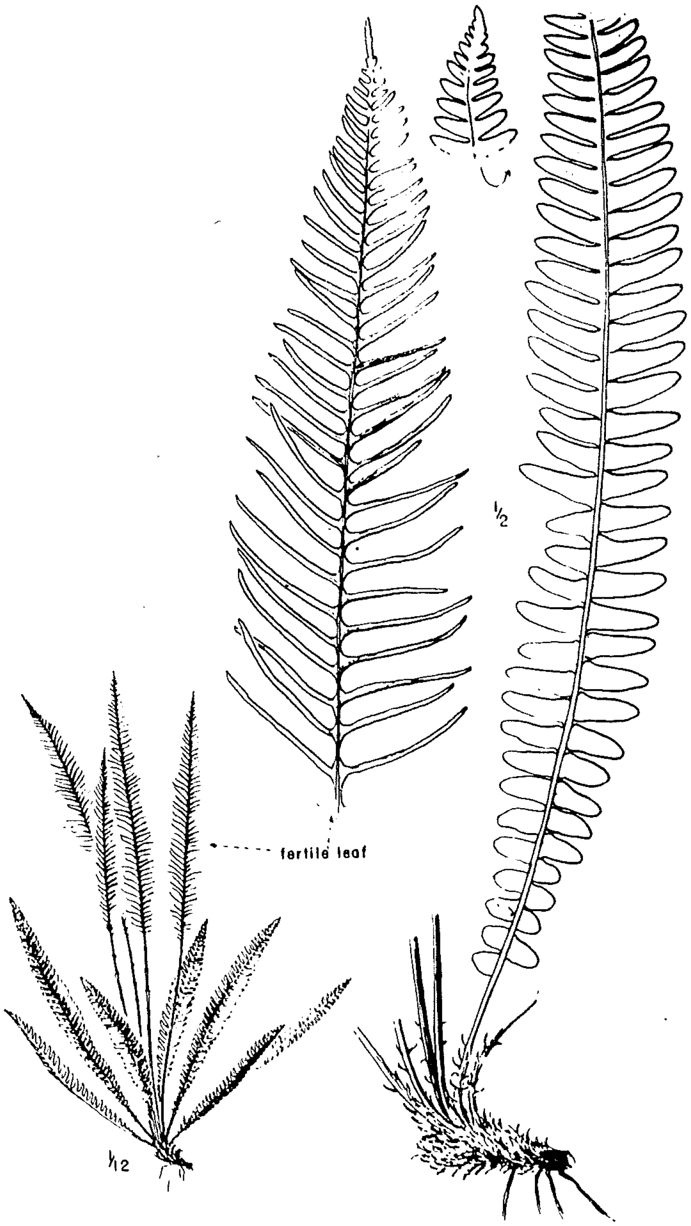
(Actr)



LADY FERN

<u>Athyrium</u> <u>filix-femina</u>

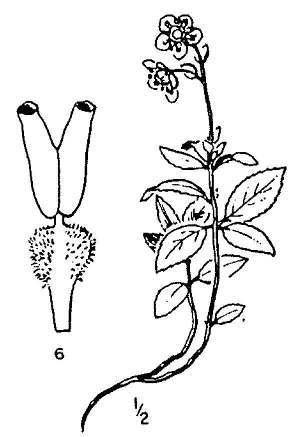
(Atfi)



DEER FERN

Blechnum spicant

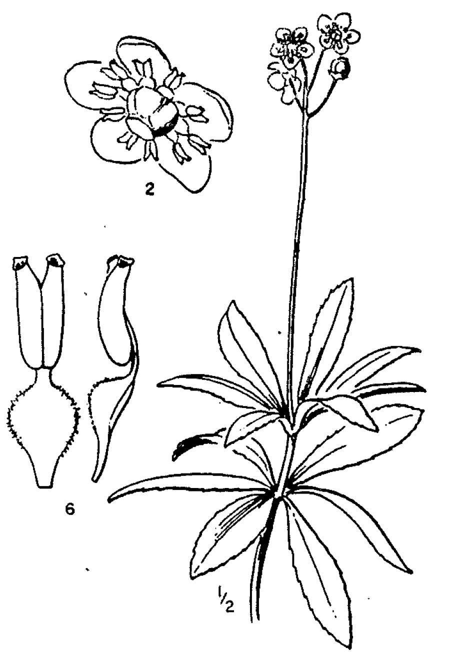
(Blsp)



LITTLE PIPSISSEWA

Chimaphila menziesii

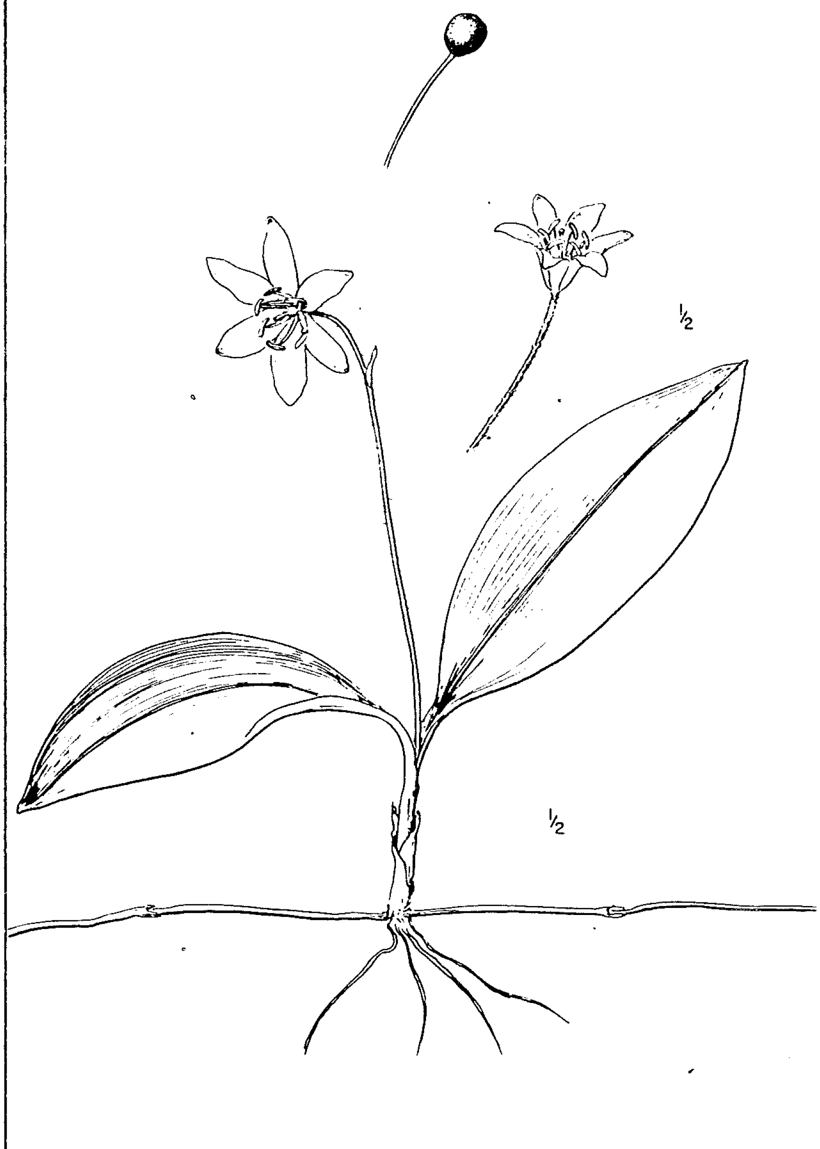
(Chme)



COMMON PIPSISSEWA

Chimaphila umbellata

(Chum)



QUEEN'S CUP

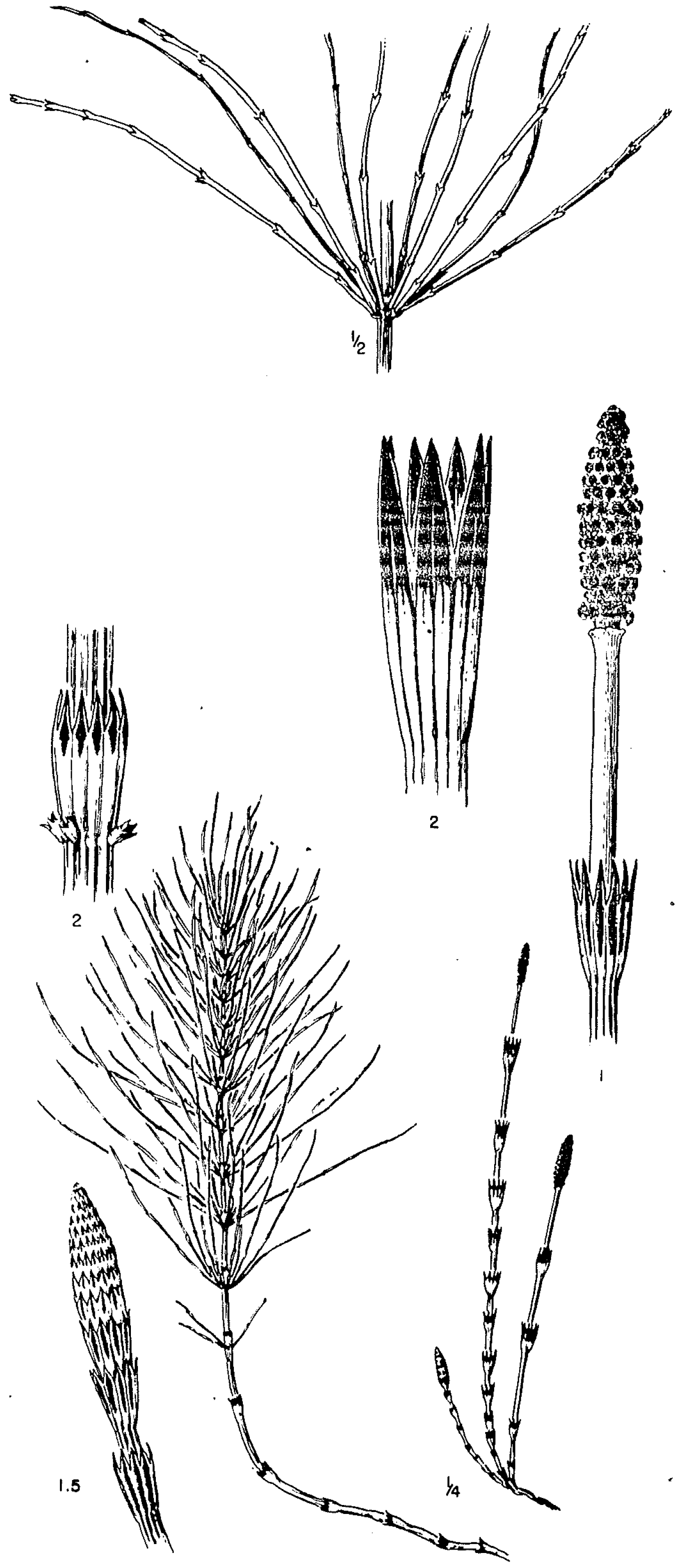
Clintonia uniflora

(Clun)

BUNCHBERRY

<u>Cornus</u> <u>canadensis</u>

(Coca)



COMMON HORSETAIL

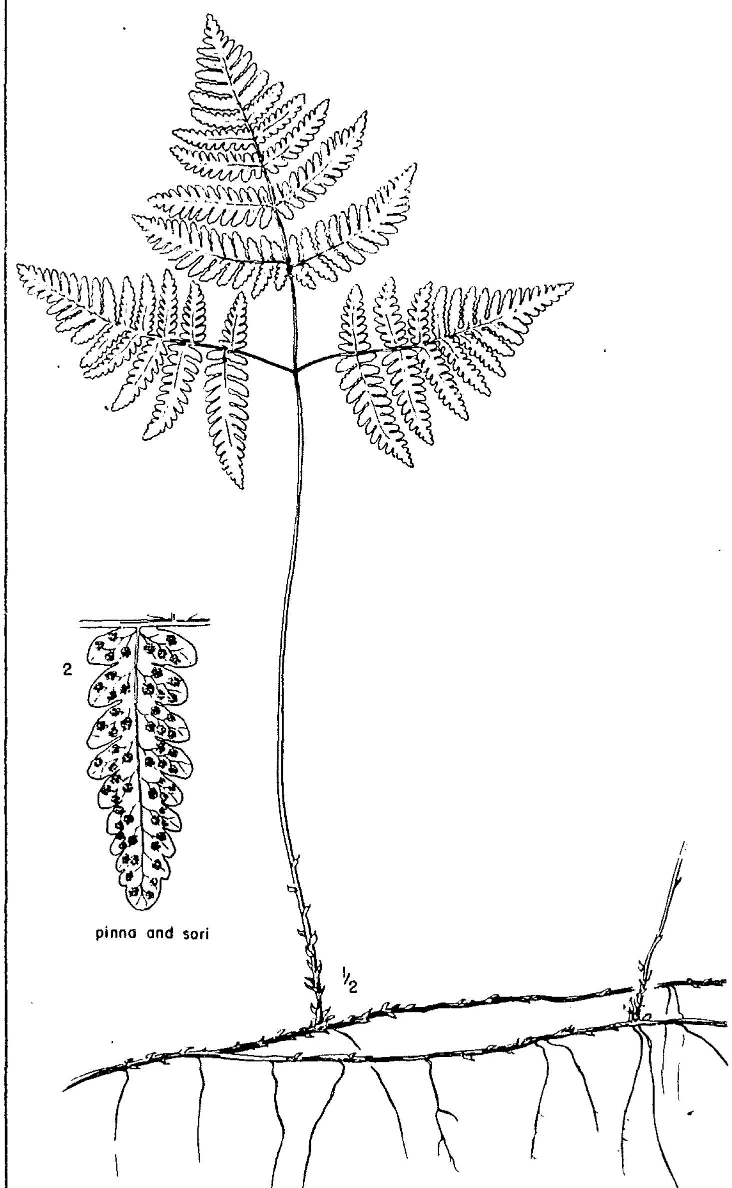
<u>Equisetum</u> <u>arvense</u>

(Eqar)

AVALANCHE FAWNLILY

Erythronium montanum

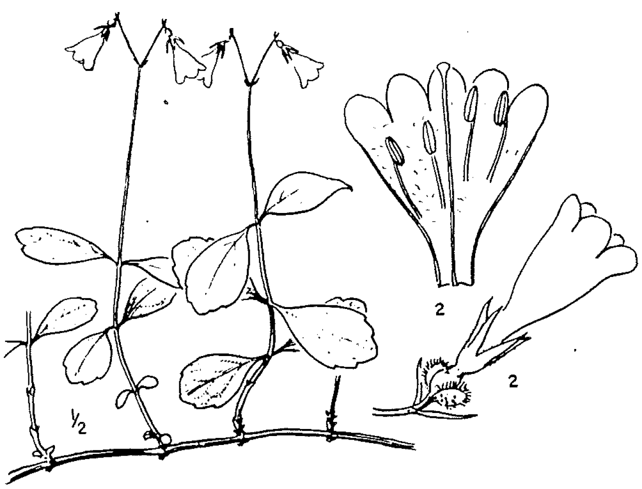
(Ermo)



OAK FERN

Gymnocarpium dryopteris

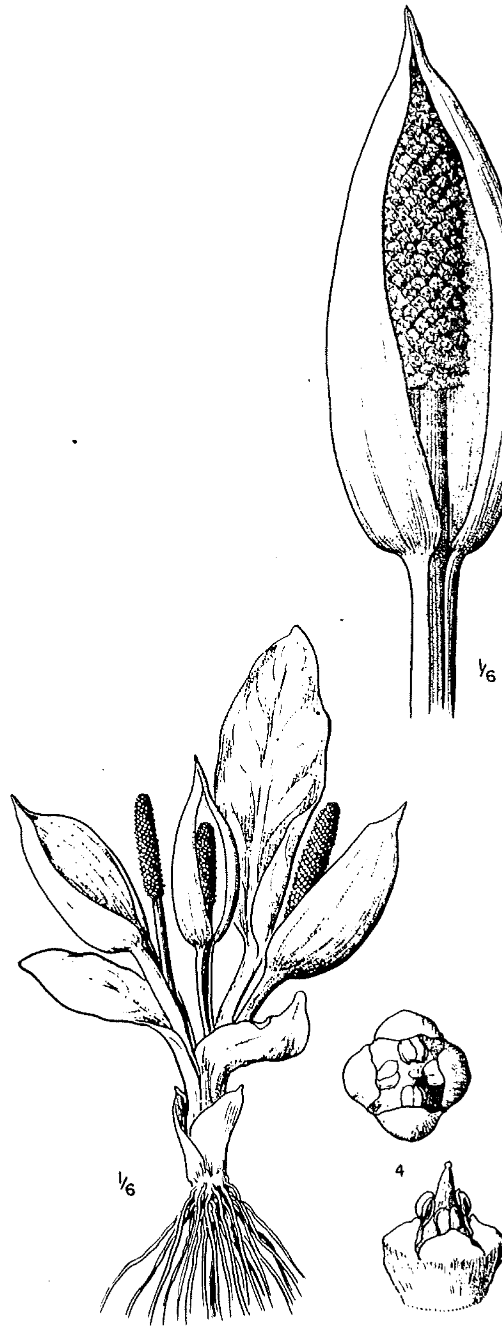
(Gydr)



TWINFLOWER

Linnaea borealis

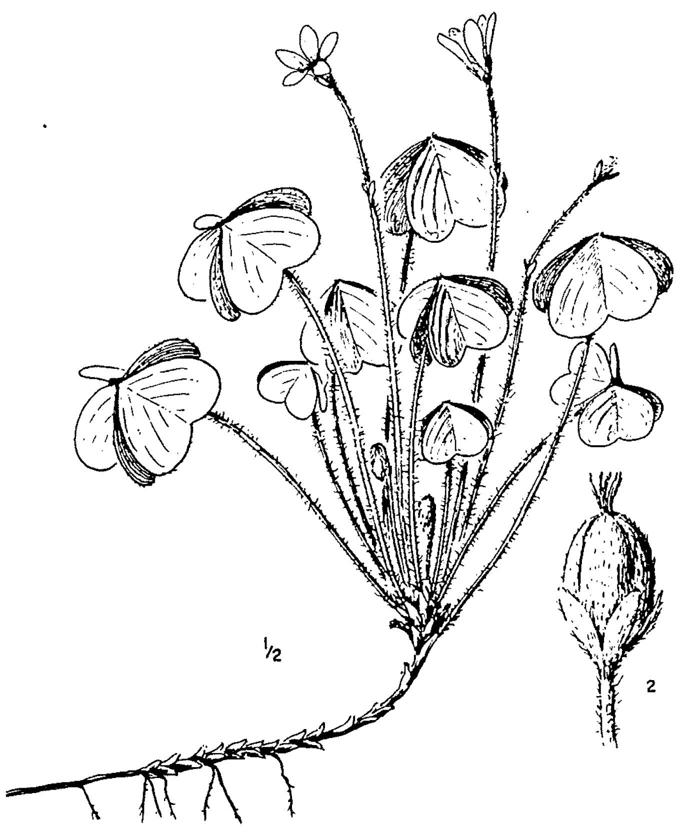
(Libo2)



SKUNK CABBAGE

Lysichitum americanum

(Lyam)



OREGON OXALIS

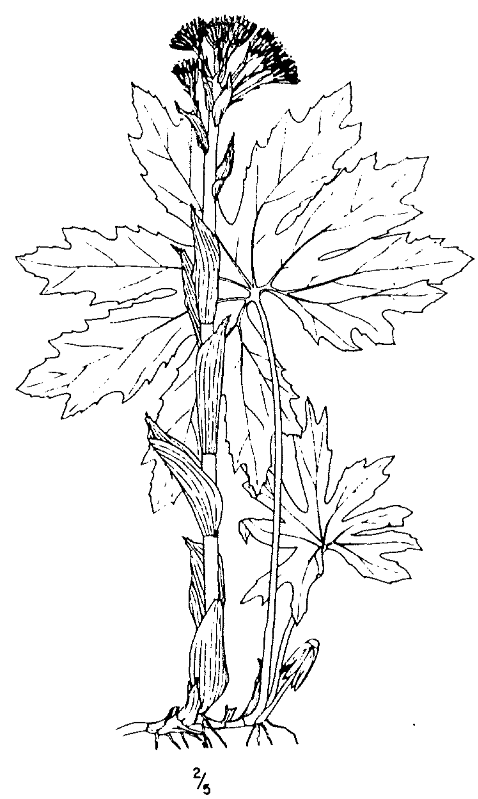
Oxalis oregana

(Oxor)

LEAFY LOUSEWORT

Pedicularis racemosa

(Pera)

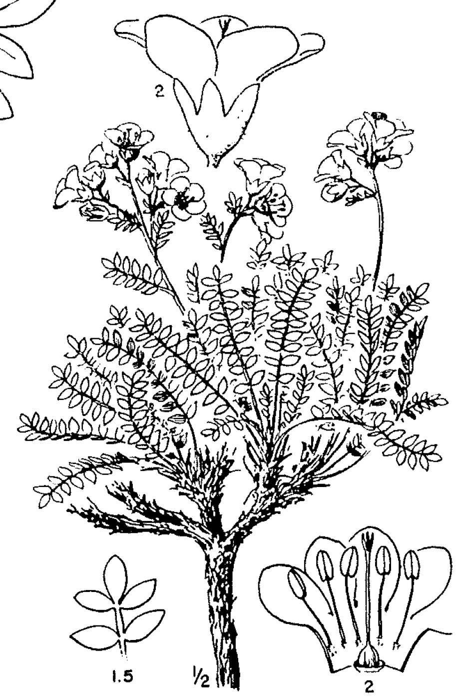


SWEET COLTSFOOT

Petasites frigidus palmatus

(Pefrp)

Polemonium pulcherrimum var. calycinum

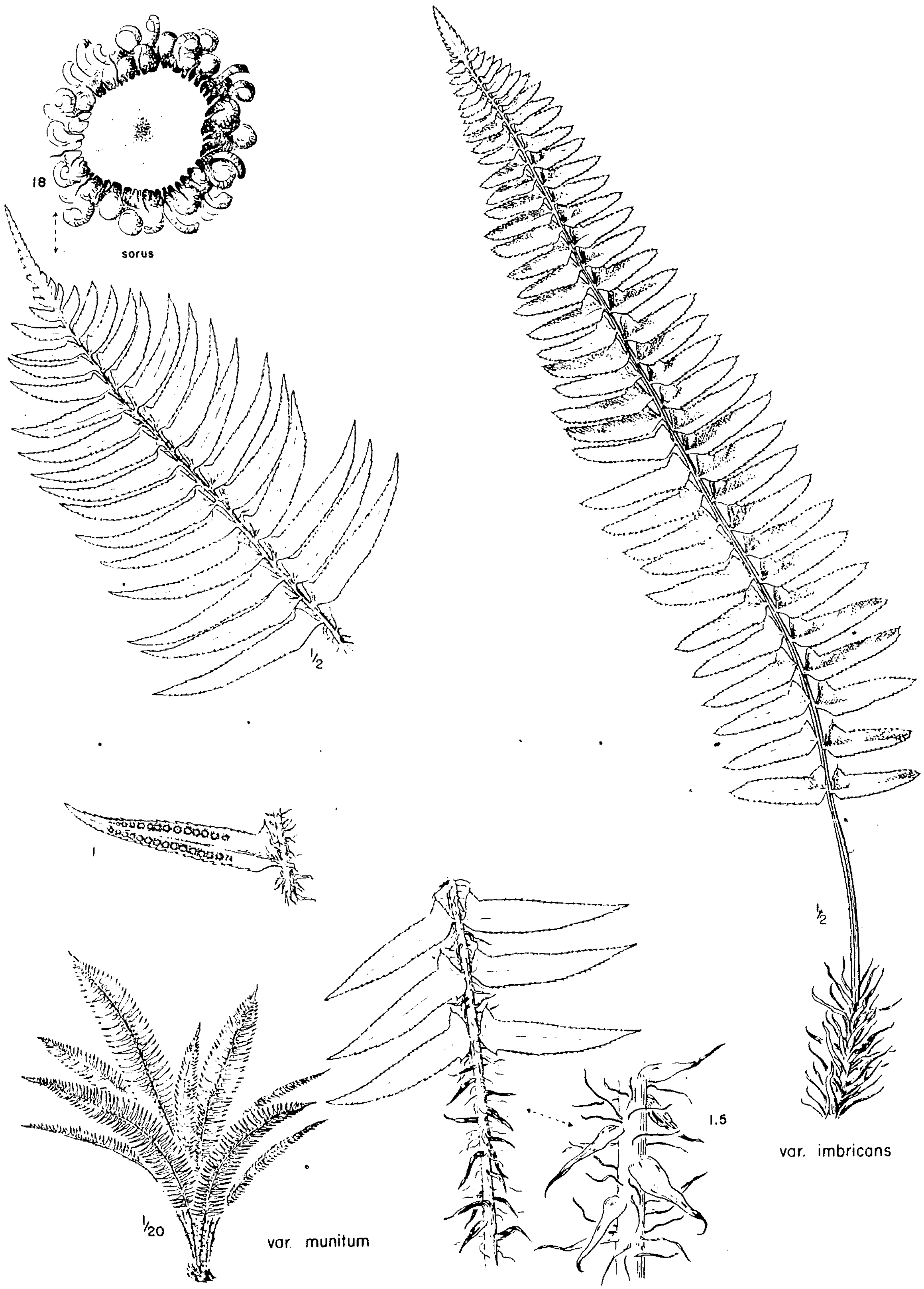


P. pulcherrimum var. pulcherrimum

SKUNKLEAF POLEMONIUM

Polemonium pulcherrimum

(Popu)



SWORDFERN

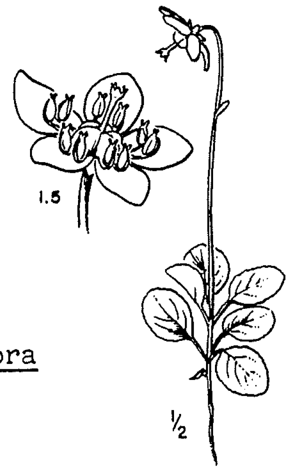
Polystichum munitum munitum

(Pomum)

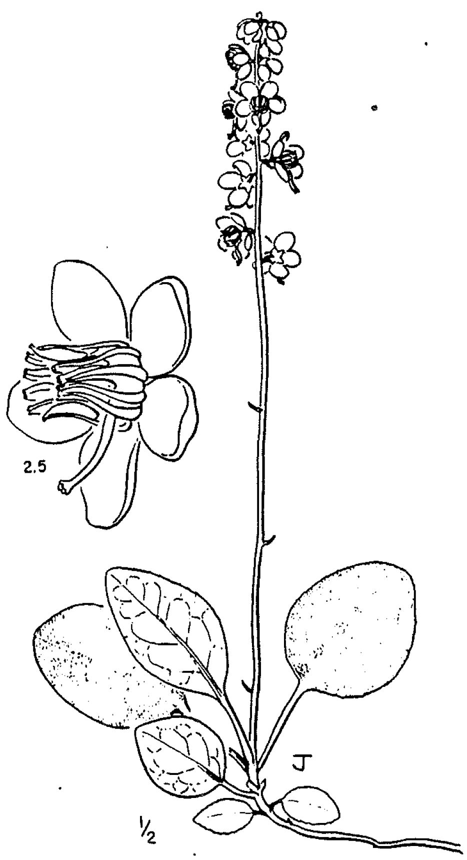
WOODNYMPH

Pyrola uniflora

(Pyun)



P. uniflora



WHITEVEIN PYROLA

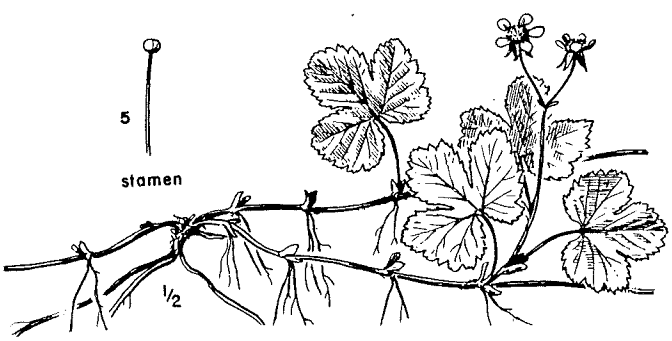
Pyrola picta

(Pypi)

ONE-SIDED PYROLA

Pyrola secunda

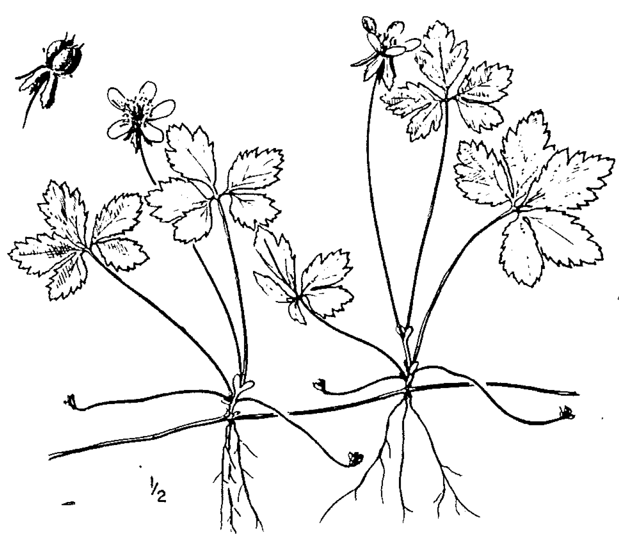
(Pyse)



DWARF BRAMBLE, TRAILING B.

Rubus lasiococcus

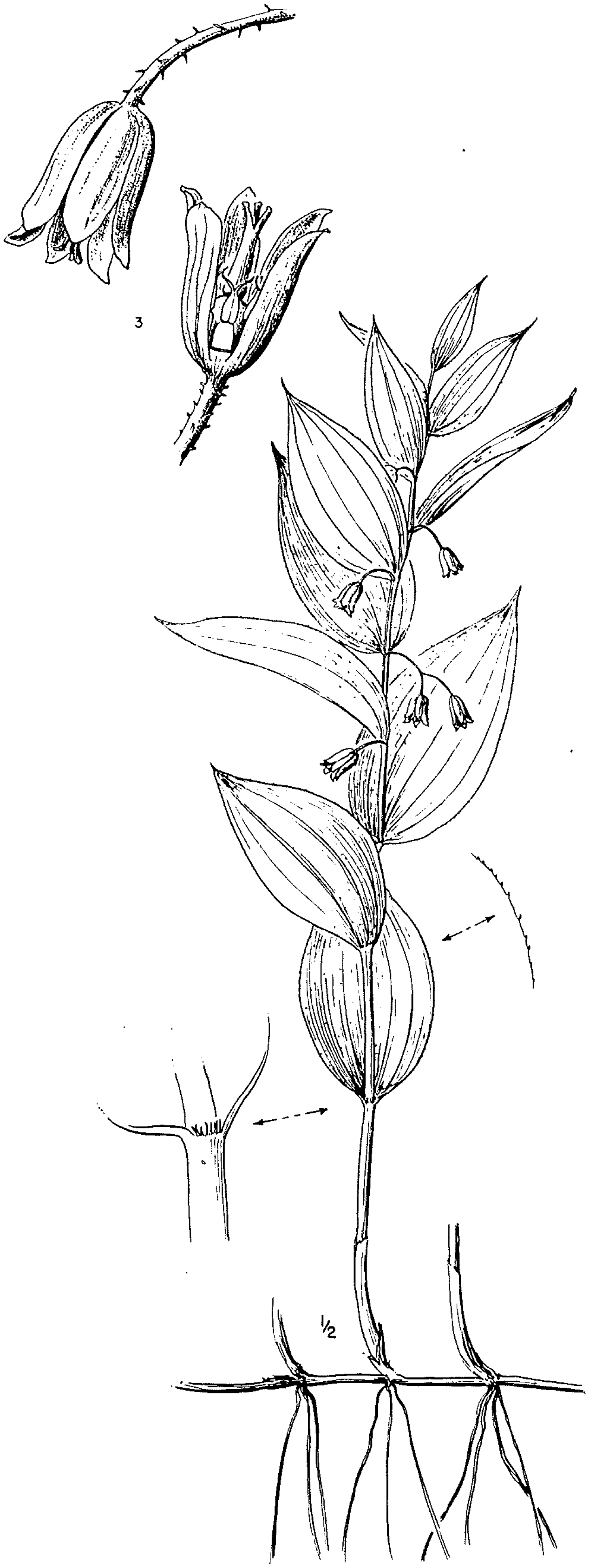
(Rula)



FIVE-LEAVED BRAMBLE, TRAILING B.

Rubus pedatus

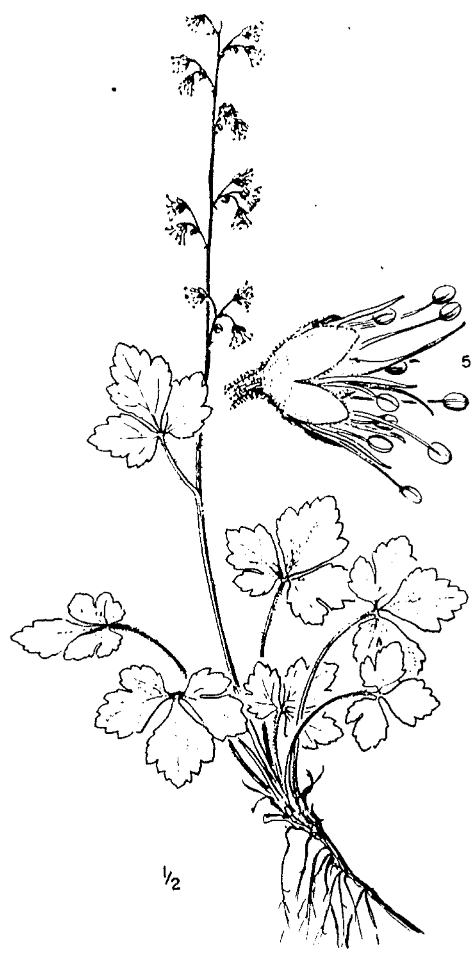
(Rupe)



ROSY TWISTED-STALK

Streptopus roseus

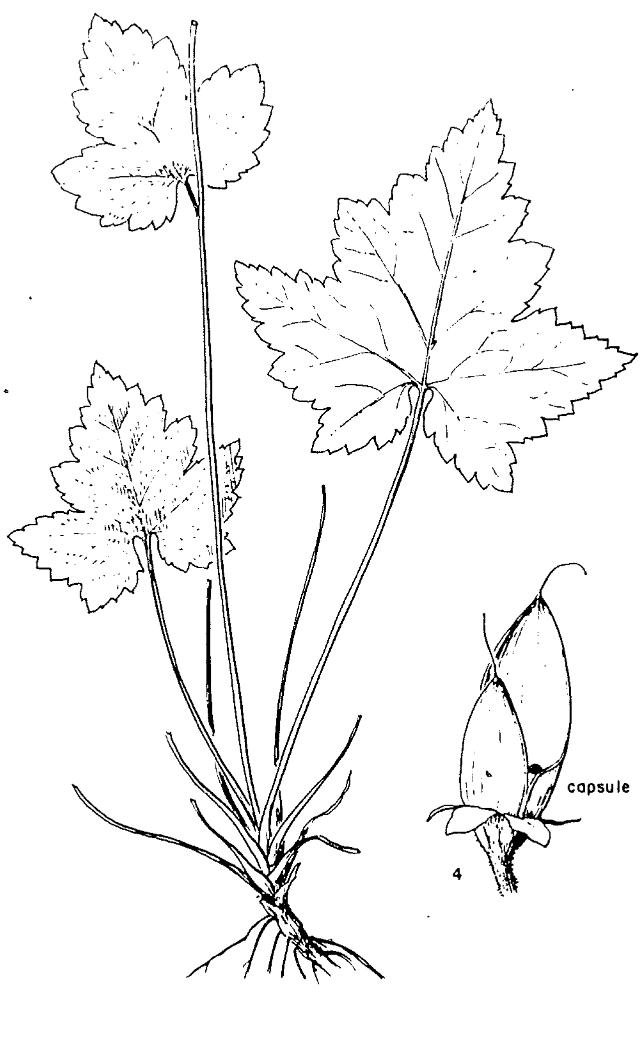
(Stro)



THREE-LEAVED FOAMFLOWER

Tiarella trifoliata

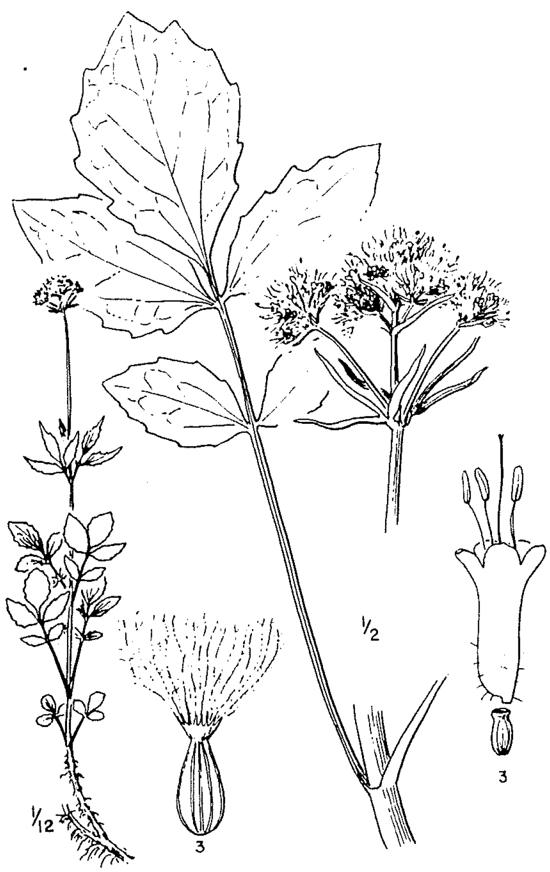
(Titr)



ONE-LEAVED FOAMFLOWER

Tiarella unifoliata

(Tiun)



SITKA VALERIAN

Valeriana sitchensis

(Vasi)

COMMON BEARGRASS

Xerophyllum tenax

(Xete)

FIELD FORM

Crew ______________		Plot			
Location ______________		Elev.			
Location ______________		Aspect			
Location ______________		Slope			

TREES

Abies amabilis	(Abam)	Silver fir			
Chamaecyparis nootkatensis	(Chno)	Alaska yellow cedar			
Pseudotsuga menziesii	(Psme)	Douglas-fir			
Taxus brevifolia	(Tabr)	Pacific yew			
Thuja plicata	(Thpl)	Western redcedar			
Tsuga heterophylla	(Tshe)	Western hemlock			
Tsuga mertensiana	(Tsme)	Mountain hemlock			
Other					

SHRUBS

Acer circinatum	(Acci)	Vine maple			
Berberis nervosa	(Bene)	Oregongrape			
Gaultheria shallon	(Gash)	Salal			
Holodiscus discolor	(Hodi)	Oceanspray			
Menziesia ferruginea	(Mefe)	Fool's huckleberry			
Oplopanax horridum	(Opho)	Devil's club			
Rhododendron albiflorum	(Rhal)	White rhododendron			
Ribes bracteosum	(Ribr)	Stink currant			
Rubus spectabilis	(Rusp)	Salmonberry			
Vaccinium alaskaense	(Vaal)	Alaska huckleberry			
Vaccinium membranaceum	(Vame)	Thinleaved huckleberry			
Vaccinium ovalifolium	(Vaov)	Ovalleaf huckleberry			
Vaccinium ovatum	(Vaov2)	Evergreen huckleberry			
Vaccinium parvifolium	(Vapa)	Red huckleberry			

HERBS

Achlys triphylla	(Actr)	Vanillaleaf			
Athyrium filix-femina	(Atfi)	Lady fern			
Blechnum spicant	(Blsp)	Deer fern			
Chimaphila menziesii	(Chme)	Little pipsissewa			
Chimaphila umbellata	(Chum)	Common pipsissewa			
Clintonia uniflora	(Clun)	Queen's Cup			
Cornus canadensis	(Coca)	Bunchberry			
Gymnocarpium dryopteris	(Gydr)	Oak fern			
Linnaea borealis	(Libo2)	Twinflower			
Oxalis oregana	(Oxor)	Oxalis			
Polystichum munitum	(Pomu)	Swordfern			
Pyrola secunda	(Pyse)	One-sided pyrola			
Rubus lasiococcus	(Rula)	Dwarf bramble			
Rubus pedatus	(Rupe)	Five-leaved bramble			
Streptopus roseus	(Stro)	Rosy twistedstalk			
Tiarella trifoliata	(Titr)	Three-leaved foamflower			
Tiarella unifoliata	(Tiun)	One-leaved foamflower			
Xerophyllum tenax	(Xete)	Beargrass			

Key to the Major Associations on the Shelton District, Olympic National Forest

1. Mountain hemlock (Tsme) $\geq$ 10% cover . . . . . . (2)

2. White rhododendron (Rhal) $\geq$ 5% cover . . . . Tsme/Rhal p. 20
2. Rhal $<$ 5% cover . . . . (3)

3. Alaska huckleberry (Vaal) $\geq$ 10% cover . . . . Tsme/Vaal p. 21
3. Thinleaved huckleberry (Vame) $\geq$ 10% cover . . . . . . Tsme/Vame p. 22

1. Tsme $<$ 10% cover . . . . (4)

4. Silver fir (Abam) $\geq$ 10% cover . . . . . . (5)

5. Alaska huckleberry (Vaal) $\geq$ 10% cover . . . . Abam/Vaal p. 27
5. Vaal $<$ 10% cover . . . . (6)

6. Salal (Gash) $\geq$ 10% cover . . . . Abam/Gash p. 29
6. Gash $<$ 10% cover . . . . (7)

7. Oxalis (Oxor) $\geq$ 10% cover . . . . Abam/Oxor p. 30
7. Rosy twistedstalk (Stro) $\geq$ 5% cover . . . . . . Abam/Stro p. 31

4. Abam $<$ 10% cover . . . . (8)

8. Western hemlock (Tshe) $\geq$ 10% cover . . . (9)

9. Devil's club (Opho) $\geq$ 5% cover . . . . Tshe/Opho p. 37
9. Opho $<$ 5% cover . . . . (10)

10. Oxalis (Oxor) $\geq$ 10% cover . . . . Tshe/Oxor p. 38
10. Oxor $<$10% cover . . . . (11)

11. Oceanspray (Hodi) $\geq$ 2% cover . . . . . . Tshe/Hodi p. 39
11. Hodi $<$ 2% cover . . . . . . (12)

12. Salal (Gash) $\geq$ 10% cover . . . . . . Tshe/Gash p. 40
12. Gash $<$ 10% cover . . . . (13)

13. Alaska huckleberry (Vaal) $\geq$ 10% cover . Tshe/Vaal p. 43
13. Vaal $<$ 10% cover . . . (14)

14. Swordfern (Pomu) $\geq$ 10% cover . . Tshe/Pomu p. 44
14. Pomu $<$ 10% cover . (15)

15. Vine maple (Acci) $\geq$ 10% cover . Tshe/Acci p. 47
15. Oregongrape (Bene) $\geq$ 5% cover . Tshe/Bene (TBE)

8. Tshe $<$ 10% cover, Douglas-fir (Psme) dominant, Oceanspray (Hodi) present . . . . Psme/Hodi p. 50